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RAILWAY
MECHANICAL ENGINEER

The Evolution of

The Locomotive in France*

By Lawford H. Fry †

In the December issue of the *Railway Mechanical Engineer,* a review of Mr. Chapelon's book was begun, but the important section on Thermal and Thermodynamic Studies of the Steam Locomotive was reserved for more detailed consideration. The study covered by this section is not purely academic theory. Much of it originated in a desire to increase the power of existing locomotives; and as a result of this study and of the experiments made for its support, definite and important improvements were made.

Work began some fifteen years ago when many novel types of turbine and high-pressure locomotives were being built and discussed. The French railways required an increase in locomotive power, but felt that before starting out along these new paths the possibilities of the more conventional designs should be thoroughly explored.

As a result of extensive study, the Paris-Orleans Railway decided in 1924 to rebuild along improved lines one of their Pacific type locomotives. The engine chosen was a four-cylinder compound superheated Pacific type locomotive of the class built from 1910 to 1914. On the basis of theoretical study and experimental work it was believed that increased power could be obtained in three ways:

1—Improvement in the exhaust and front end so as to obtain greater boiler power while reducing the amount of back pressure required to produce draft. This reduction of back pressure would increase the engine power available.

2—Increase in the cross-sectional area of the steam passages between boiler and exhaust. This would reduce wire drawing and its attendant losses and by reducing back pressure would increase efficiency and facilitate high-speed running.

3—Increase in the steam temperature to reduce cylinder condensation with its attendant losses.

Practical Application to P.-O. Locomotives

The preliminary studies and experiments gave grounds for believing that by taking advantage of all possibilities in these three directions, the locomotives then developing about 2,000 hp. could be rebuilt to deliver approximately 3,000 i.hp. Mr. Chapelon shows that the results met all predictions. Before considering the theoretical studies a brief account of the practical developments is given.

Exhaust and Front End

The system used is the "Kylchap," developed by Mr. Chapelon on the basis of the distributor introduced by the Finnish engineer, Mr. Kylala. Two stacks are used, each having an independent draft rigging and nozzle. The blast nozzle is circular with Goodfellow bars. The nozzle discharges the steam into the wide circular bell-mouth of the distributor. This distributor at a short distance above the nozzle splits into four passages which taper so as to reduce the area slightly. The steam and gases are discharged from the distributor in four jets directly into the wide circular mouth of a petticoat pipe which ends a few inches below the lower rim of the wide bell-mouth of the stack extension.

The test results quoted for this draft arrangement show it to be highly efficient. Whether the Kylchap arrangement is compared with the earlier French drafting or with modern American practice, great improvement is shown. With 8 lb. per sq. in. of back pressure the Kylchap draft in the remodeled Orleans locomotive produces a smokebox draft about 18 in. of water. In the older Orleans locomotives and in American practice this same back pressure, 8 lb. per sq. in., would give a draft of only about 8.5 in. of water. To produce the draft necessary to give full boiler power without the Kylchap exhaust, it would be necessary to carry the back pressure 8 or 10 lb. per sq. in. higher. With a 22-in. by 28-in. cylinder locomotive at diameter speed, a reduction of 10 lb. per sq. in. in back pressure means an increase of 360 hp. in the indicated cylinder horsepower.

Steam Passages

Mr. Chapelon points out that in earlier studies of locomotive thermodynamics insufficient attention had been given to providing sufficient cross-sectional area for the steam passages in the cylinders. Tradition prevailed and the ratio of port area to piston area remained for many years about 1 to 10. Similar proportions are not uncommon in American practice. Definite improvement was made by the Northern Railway of France in 1907 when steam passages were increased 25 per cent to permit high speeds with low driving-wheel diameters. With this precedent the Paris-Orleans decided to go still further, practically doubling the steam passages and thus dividing by four the loss of pressure due to wire drawing. At the same time the volume of the steam chests was increased. This helped to equalize the pressure in the steam chest throughout the stroke.

Superheat

The steam temperature was increased to 750 deg. F. and by increasing the steam passages through the superheater, the pressure drop between throttle and high-pressure cylinders was greatly reduced.

With the changes indicated, the Paris-Orleans in 1934 rebuilt a 4-6-2 Pacific type, replacing the trailer with an additional pair of drivers, thus producing a 4-8-0 engine which, as has been indicated, with an increase of only 11 tons in weight enabled the indicated horsepower to be increased from 2,200 to 3,700.

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* Part II of a review of La Locomotive a Vapeur by André Chapelon, assistant chief engineer of design of equipment, Paris-Orleans-Midi Railway, published by J. B. Bailliere et Fils, 19, Rue Hautefeuille, Paris, 6e, France. Price, 125 francs.

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With these figures to show the theoretical studies have been used to definite practical purpose, the Section on Thermal and Thermodynamic Studies of the Steam Locomotive is reviewed.

Corelation of Two Streams of Fluid Flow

The first chapter deals with Fluids in Movement and examines the fundamental relationships connecting boiler, engine and exhaust with the tractive force, speed and horsepower developed.

The operation of the steam locomotive depends on two streams of fluid flow which originate separately and join at the exit of the exhaust nozzle. In one channel the fuel and atmospheric air combine in the firebox to form gases of combustion which flow through the tubes to the smokebox and stack. In this channel heat is developed and transferred as far as possible to the steam in the other channel, in which the water is evaporated, the steam superheated, and then part of the transferred heat is transformed into mechanical work in the cylinders. Finally part of the heat energy remaining in the steam is utilized in the exhaust to maintain the flow of gases. The expansion of the steam in the exhaust induces the flow of gases on which combustion and hence the production of the steam depends. This linked flow beginning and ending in the exhaust nozzle is, as Mr. Chapelon points out, self-supporting. The steam exhausted produces sufficient draft to maintain the combustion required to evaporate the steam required to produce the draft. The cycle involves the complicated interplay of a number of actions and reactions, physical, chemical, and mechanical. The chapter under consideration attempts an analysis of the details of the cycle.

The Flow of Gas and Air

Eight so-called Laws are set up, but these are better described as approximations and not as laws. As, however, the approximate relations are compared with those derived experimentally, the method is instructive. Starting with the exhaust nozzle, the back pressure is shown to be very nearly proportional to the square of the rate of flow of steam; the smokebox draft is nearly proportional to the back pressure, but does not increase quite so rapidly as the latter when the rate of evaporation is increased; the loss of pressure in the steam between boiler and steam chests is approximately proportional to the square of the rate of flow of steam and inversely to the square of the cross-sectional area of the passages.

These three relations are dealt with satisfactorily, but in the next, Law IV, more difficulty is encountered. The relation involved is that which leads to balance between the steam exhausted and the steam produced. The links in this relationship are: the amount of steam exhausted determines the smokebox draft; the draft and the resistance of the boiler determine the rate at which air is taken in; and the rate of air supply determines the rate of combustion and steam production. The relationship is correctly stated, and Mr. Chapelon concludes that as boiler output increases, there is a decrease in the amount of air taken in per pound of coal burned, and at the same time a slight decrease in the resistance of the boiler to the flow of gas.

This last conclusion is arrived at from theoretical considerations with very little experimental data in support. Direct information could have been obtained by plotting weight of gases moved against smokebox draft. By doing this the reviewer has found that the resistance offered by the boiler to the flow of air and smokebox gases remains constant until, at very high rates of firing, the fire begins to lift on the grate. In the Pennsylvania Mla locomotive the boiler resistance is constant up to a boiler output of about 50,000 lb. of steam per hour. Until that rate of evaporation is reached, the weight of gases moved is directly proportional to the square root of the smokebox draft, and it is found that very nearly one-half of the draft is required to move the gases through the tube bundle, the remaining half overcoming the resistance in the smokebox and through the grate.

Mr. Chapelon's analysis of these phases of boiler operation lacks completeness because he is not able to offer any definite information as to the weight of gas moved in relation to the weight of steam exhausted. This ratio of weight of gas to weight of steam is the only proper criterion of the effectiveness of the exhaust. In this country methods have been developed for using locomotive smokebox gas analysis to compute the weight of coal actually burned and the weight of gas moved. Mr. Chapelon notices this method, but expresses doubt as to its reliability. It is unfortunate that he did not explore its possibilities when making the elaborate tests of the Orleans engines on the road and on the test plant. He would then be in a better position to decide as to the merits of the method. As it is, while rejecting the method in principle, he quotes on several occasions Altoona test plant results which were computed by it.

After this digression, we note that the analysis of the flow of gas and air is closed by plotting boiler efficiency and evaporation with rate of coal fired as abscissa. Mr. Chapelon credits this form of plot to the present reviewer. This method of plotting has the advantages that it leads to a straight line relation between efficiency and rate of firing and that from this it follows that the evaporation tends to a maximum value at an efficiency just half that indicated by the straight line if extended back to zero rate of firing.

The Steam Flow

This concludes the examination of the combustion side of the flow and attention is turned to the travel of the steam from boiler through the cylinders to exhaust. The interrelations of steam pressures and steam temperatures, pressure drop to cylinders, cut-off, and back pressure are studied by an algebraic analysis which cannot be summarized here. It deserves careful study, as it emphasizes the individual importance of the various factors which control the development of power in the cylinders.

Mr. Chapelon calls particular attention to the advantage of providing steam passages of ample cross section so as to reduce pressure drop and back pressure to a minimum. Figures are given to show how piston leakage and cylinder-wall effect reduce the amount of power that can be developed. The loss from this source decreases as cut-off is shortened and speed is increased, while steam-pressure losses ahead of and back of the pistons increase with speed and rate of steam flow. The net result is that as the speed is increased, with cut-off constant, the cylinder tractive force drops, but not so rapidly as would be the case if the cylinder losses were not reduced by the increase in speed.

Plots of experimental results from the Paris-Orleans locomotives show that for each cut-off the cylinder effort drops with increasing speed following a straight-line relationship. The slope of the lines for the short cut-offs is much less than the slope for the longer cut-offs. Also for the same cut-off the modern locomotives with ample steam passages show a much less rapid drop in cylinder effort as speed increases; in fact with the shorter cut-offs the line is very nearly horizontal, indicating that until the limit of the boiler capacity is reached, cylinder tractive force does not drop as speed increases. This is shown to be most important in its influence on the amount of steam required per indicated horsepower-hour. In the locomotives with steam passages of conventional cross-section the curve for steam per indicated

horsepower-hour plotted on indicated horsepower as abscissa drops at first, showing an increase in efficiency, but as the horsepower increases the greater flow of steam builds up back pressure in the restricted passages and the curve turns up, showing a rapid drop in efficiency. This means a rapid increase in steam consumption and consequently a comparatively low ceiling for the horsepower that can be developed. With enlarged steam passages the curve for steam per horsepower-hour is flattened out at the higher horsepowers, and a greater horsepower output is possible.

The Boiler and Fuels

The boiler comes next for study. After some notes on types of fuel including tabulation of the petrographic constituents of coal a glance is thrown in the direction of the firing shovel, the firebox door, as well as the Hulson grate and the Standard stoker. The pulverized coal burners experimented with on the German State Railways are pictured, together with two oil burners. Then, coming to the practical use of coal fuel, Mr. Chapelon contributes a valuable and interesting chapter. He points out that the value of a coal as a locomotive fuel is closely connected with its coking power. The coking power of the coal is of importance not only in keeping the fine coal from being carried off the grate, but in insuring that the fire forms a porous permeable bed. This is essential if the boiler is to be driven to high capacity. To determine the value of a coal as locomotive fuel, it is not sufficient to determine its heating value, the melting point of the ash, and to make proximate and ultimate analyses. It is of the highest importance to know how the coal will behave in the firebox.

To emphasize this point, figures are given for locomotive tests with two apparently similar coals. The proximate analyses were:

Coal:	A	B
Upper heating value, B.t.u. per lb.	15,480	15,120
Ash, per cent	4.1	4.8
Volatile matter, per cent	21 to 22	17 to 19
Moisture, per cent	2.1	2.0
Boiler efficiency at		
80 lb. per sq. ft. grate per hr., per cent	67	75
165 lb. per sq. ft. grate per hr., per cent	49	57
Smokebox draft at		
80 lb. per sq. ft. grate per hr., in. of water	3.5	5.0
165 lb. per sq. ft. grate per hr., in. of water	12.2	14.7

These figures are taken from an elaborate series of tests with four Pacific type locomotives run by the same fireman. In all cases 60 per cent of coal and 40 per cent of briquettes were fired, the briquettes being the same for both series of tests. The only difference between the two coals was that *A* had been in stock for a longer time and the consequent oxidization had reduced its coking power. In the firebox the fresh freely coking coal *B* formed a permeable fire-bed through which the air flowed uniformly giving efficient combustion. This accounts for the higher draft with coal *B*. Although the higher draft produced a slightly higher spark loss, the better combustion in the fire-bed gave a higher net boiler efficiency with coal *B*. Mr. Chapelon concludes that for locomotive use the coking power of a coal is at least as important as, if not more important than, its heating value. Methods of studying the coking power of coals are noted.

Combustion

In closing the chapter on combustion, Mr. Chapelon gives figures for the air required and the heating value of a wide variety of fuels solid, liquid, and gaseous. From these it appears that whatever fuel is used, the heat released per pound of air required will be very nearly constant. Translated into American units, Mr. Chapelon's figures show that for each pound of air burned, 1,270 B.t.u. will be produced. The reviewer's notebook carries an entry several years old giving 1,360 B.t.u. per pound of air. For mnemonic convenience a figure of 1,300 B.t.u. per pound of air can be taken. The constancy of this figure explains why the boiler barrel and front end are only slightly affected by the kind of fuel to be burned.

A short chapter deals with the theory of the exhaust. Plotting with smokebox drafts as abscissae it is shown that the curve representing the amount of steam produced by the draft is concave downwards, while the curve representing the amount of steam required to produce the draft is concave upwards. Evidently the draft value at which the two curves cross is that corresponding to the maximum capacity of the boiler. Mr. Chapelon points out that an inefficient front end can be forced to high draft and high boiler capacity, but at the expense of building up a high back pressure, which reduces the power of the engine. Comparison of various locomotives shows that for an equivalent evaporation of 60,000 lb. per hour, the smokebox draft required is 12.6 in. for locomotive No. 4700 and 13.0 in. for locomotive No. 4500. To produce these practically identical drafts No. 4700 with Kylchap exhaust operated with a back pressure of 5.5 lb. per sq. in., while No. 4500 with the old trefoil nozzle required 15.0 lb. per sq. in. At a speed of 68 miles an hour this represents a net difference of 365 hp. That is to say, if locomotive No. 4700 developing 2,000 hp. at the drawbar had its Kylchap exhaust replaced by the old trefoil, the drawbar horsepower would be reduced to 1,635, a reduction of 18 per cent. Put the other way round, drawbar horsepower can be increased 22.5 per cent by changing from the old to an improved type of front end. The figures deserve serious consideration on this side of the Atlantic.

The chapter on the Production of Heat then presents a sketchy account of the mechanics of combustion in the firebox, a theoretical discussion of the heat which can be produced per unit of firebox volume, and winds up with a series of curves for French and German locomotives burning respectively hand- and stoker-fired coal, pulverized coal and oil. The curves plot boiler efficiency and evaporation against rate of firing and show that the differences between one style of firing and the other are hardly greater than the variations between locomotives of different types using the same style of firing.

Heat Transmission and Absorption

The chapter following discusses Heat Transmission in firebox, flues, and superheater. Transmission by radiation in the firebox is handled mathematically and the usual Stephan-Boltzmann law is obtained showing that the rate of transmission is proportional to the difference between the fourth powers of the absolute temperatures of the radiating and receiving surfaces. The value given by Mr. Chapelon for the coefficient by which the fourth power difference is multiplied to give B.t.u. radiated per square foot of surface is about 35 per cent lower than the value which the reviewer has used. It is, therefore, a matter for regret that Mr. Chapelon offers this value without quoting any source and without comparing computed results with test data.

In dealing with transmission by convection in the flues, the drop of gas temperature along the flue is assumed to follow an exponential law, and the constants required are derived from a curve of temperature drop attributed to the Pennsylvania Railroad. The formula obtained is used to study the effect of variations in boiler proportions. It is pointed out that a change in flue dimensions which increases efficiency of heat transfer increases at the same time the resistance to the flow of the gases. A general equation for drop of pressure because of flue resistance is given, but no numerical values are given.

A general study of superheater proportions is made and eight different designs are compared.

To provide information as to the relative heat absorption in firebox and flues, Mr. Chapelon uses H. S. Vincent's work at some length, but decides that in view of the difficulty of measuring firebox temperatures and in determining the weight of gases of combustion, the results quoted must be considered as provisional only. It is perfectly true that values reported for firebox temperatures must be used with reasonable care, but Mr. Chapelon's position regarding the determination of the weights of the gases of combustion does not seem to be so well founded and is not entirely consistent. In discussing the efficiency of absorption of the boiler heating surfaces, the statement is made that this efficiency varies little from one locomotive to another and is only slightly affected by the rate at which the boiler works. This statement is supported by curves derived from a number of tests made on American locomotive plants. Now this efficiency of absorption can be found only when the weight of gases of combustion is known, so that the accuracy of the values of absorption efficiency given by Mr. Chapelon is entirely dependent on the accuracy with which the weight of the gases of combustion has been determined.

The same holds for Mr. Chapelon's figure showing for the Pennsylvania Mla locomotive the over-all boiler efficiency, as well as the efficiencies of heat production and heat absorption. The over-all efficiency is measured directly and is split into the efficiencies of heat production and absorption, the computation requiring a knowledge of the weight of the products of combustion. The smooth curves in both of the figures referred to indicate that there is no undue inaccuracy in the determination of the weight of the gases of combustion. It seems a pity that Mr. Chapelon did not give greater attention to the problem of measuring the weight of the gases of production. If an effective analysis of boiler operation is to be made, knowledge of the weight of air supplied is as fundamentally essential as knowledge of the weight of coal fired. In many of his discussions of the action of the boiler, Mr. Chapelon can give definite information only because methods for determination of the air supply have been developed in this country. The extensive tests made with the Orleans locomotives on the road and on the Vitry test plant offered excellent opportunities for confirming or correcting these methods. It is to be regretted that this was not done.

The effect of feedwater heating is analyzed, leading to the following conclusions: feedwater heating is more effective with high steam pressures than with low; feedwater heating leads to a slight decrease in the amount of superheat; the saving in heat is greater than the saving in water, and the saving in coal is greater than the saving in heat. A brief survey of exhaust injectors and feedwater heater closes the section devoted to the boiler.

Action of Steam in the Cylinders

The Section devoted to the Action of Steam in the Cylinders is the most important part of the book. It starts with first principles, introducing the general study of thermo-dynamics by a quotation of some length from Sadi Carnot's "Reflections on the Motive Power of Fire," 1824, and following this by Clausius, 1888. The thermodynamic theory of the steam engine is developed and is then used to show the possible advantages of high boiler pressures and more particularly of low exhaust pressures. Theory is not divorced from practical considerations, as Mr. Chapelon emphasizes the fact that real improvement is not necessarily obtained by improving the Rankine cycle. It is important to see that the improvements are effective in the locomotive as built. This is kept well in mind in discussing the effect of high pressures and of superheat.

Theoretical diagrams are shown for the Rankine cycle for pressures of 64, 240, and 850 lb. per sq. in. absolute with saturated steam and with steam at 750 deg. F., respectively. Expansion is supposed to extend down to 15 lb. per sq. in. absolute. The thermal efficiencies are:

Steam pressure lb. per sq. in.	Thermal efficiency		Gain by superheat per cent	Humidity of steam after expansion	
	Saturated	750° F.		Saturated	Superheated
64	9.4	12.0	27.7	8.5	0.0
240	17.3	19.5	12.7	16.0	2.5
850	23.6	25.6	8.5	24.6	13.4

At first sight it appears that the gain by superheating decreases as the pressure increases. Actually, however, this is not the case. The increasing ratio of expansion required for the high pressures brings with it a considerable amount of condensation in the cylinder. The action of the cylinder walls, which makes the efficiency of the real cycle lower than that of the Rankine, increases with the humidity of the steam. Therefore, with the higher pressures, high superheat is essential to prevent condensation during expansion. This whole section of the book is valuable in establishing basic theoretical relations which must be recognized in any intelligent attempt to improve the steam locomotive. It is by following the principles thus established that the very highly efficient Orleans locomotives have been developed. In view of the fact that these locomotives are four-cylinder compounds, Mr. Chapelon's discussion of compounding is of considerable interest. The present reviewer made the acquaintance of the compound locomotive more than a third of a century ago and still thinks that it is worthy of careful consideration in American practice. Students of Mr. Chapelon will probably agree.

Mr. Chapelon's use of the entropy diagrams in analyzing the action of the steam in locomotive cylinders shows clearly the very large losses produced by wiredrawing of the steam in entering and leaving the cylinders. It was a study of this kind which led to the decision of the Paris-Orleans Railway to rebuild their Pacific type locomotives with greatly enlarged steam passages. Mr. Chapelon points out that in the early days of the steam engine the ratio of 5 to 1 for area of piston to area of steam passages was recommended and used by successful builders of stationary engines, but with the development of the locomotive steam passage areas were reduced, either with the idea of reducing external heat losses, or to save weight; the ratio of 10 to 1 for piston area to steam passage area was adopted. This ratio was followed with almost religious exactitude until the Paris-Orleans broke with tradition and opened the way to greater efficiency and greater power. Incidentally, it is noted that if full advantage is to be taken of passages of large area, steam chests of ample volume must be provided. A volume at least equal to that of one cylinder is recommended for the steam chest. The object of this volume is to equalize during each stroke the flow of steam through the passages. With too small a steam-chest volume, the pressure in the chest will show violent fluctuations.

The opening up of the steam passages played a considerable part in the improvement made by the Paris-Orleans in their Pacific type locomotives. As already pointed out, these locomotives were rebuilt with a view to obtaining greater power. The front end was modified to use a double Kylchap exhaust with two stacks, the superheater was modified to give greater superheat with less loss of pressure, and the area of the steam pipes was increased from one-tenth to one-fifth of the area of the piston. As a result the indicated horsepower was increased from a value of 2,200 to about 3,700 hp. Of this increase about one-half is attributed to the increase in the size of the steam passages, while a large part of the remainder was due to the greater efficiency of the

front end which enabled a lower back pressure to be used. In this connection Mr. Chapelon points out that improvement in the front end permitting the use of a larger blast nozzle cannot be effective unless the exhaust steam passages are of ample cross section. To produce an effective blast the nozzle must be the most constricted area of the exhaust passages. Therefore, the area of blast nozzle required for the required steam production must be determined and the steam passages then proportioned to have an area larger than that of the nozzle.

At this point Mr. Chapelon gives no theoretical guidance for the design of the blast nozzle. He says that the blast has two functions. In the first place, the nozzle and distributors must mix the steam with the gases of combustion in effective fashion so that the latter are drawn through the flues and front end. No equations are available; experience must govern. In the second place, after gathering the gases, the steam expands with them through the stack, driving against atmospheric pressure to maintain the draft in the smokebox. This expansion and the relation of stack to nozzle diameter are more amenable to theory and computation.

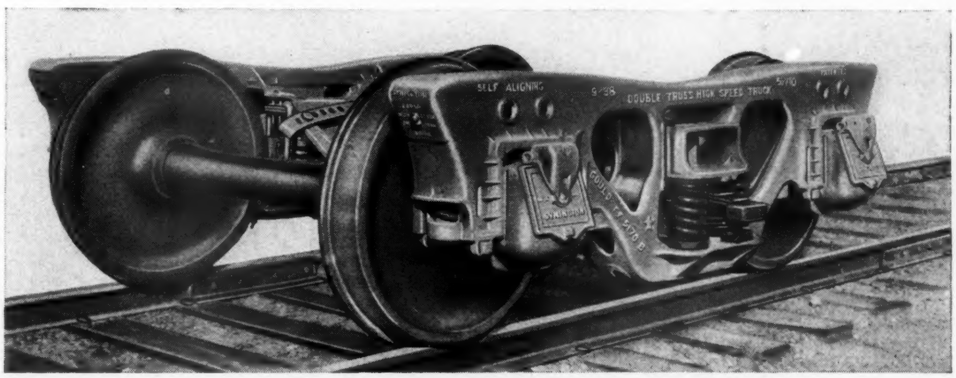
In dealing with the effect of exhaust, back pressure, steam temperature, single expansion vs. compounding, etc. Mr. Chapelon presents a considerable number of comparative diagrams of novel pattern which are very effective for the purpose. As abscissae, are plotted values of coal, water or calories used per hour, while, as ordinates, are plotted values of horsepower-hours per pound of coal, per pound of water, or per calorie, according to the comparison that is to be made. The scale used is logarithmic so that curves of equal horsepower are parallel sloping straight lines. If curves are plotted for the data to be compared, direct visual comparison is easy either at equal rates of consumption or at equal rates of power output. As a result of the logarithmic plotting the distance between any two points on the same vertical is directly proportional to the percentage difference in efficiency.

Mr. Chapelon's analysis of the action of the engine in transforming heat into work is extensive and covers many phases which cannot be dealt with here. The original is warmly recommended to those who read French. Various types of poppet valve mechanisms are glanced at, but to this reviewer the thermodynamic studies of steam action and the comparisons with experimental data constitute the most interesting and important part. Something of the same sort is wanted in English, but it is certain that a comparable amount of acceptable test data could not be assembled. Even without this a statement of the basic thermodynamic facts would be valuable. It might serve as a reminder that a mere increase in dimensions is not always the best way to obtain more power. This is emphasized by the rebuilt Paris-Orleans Pacific type locomotive, round which so much of Mr. Chapelon's book is built. These engines originally gave an indicated horsepower of 2,200. By intelligent redesign they were able to deliver 3,700 i. hp., with an increase in weight of only 11 tons.

Modified Freight Truck For High-Speed Service

For more than three years the Symington-Gould Corporation has been studying the design of a truck for intermediate freight service which would approximate the riding performance of passenger type trucks but with a relatively slight increase in weight and cost over that of the present integral box freight truck. This study has involved a long series of road tests under the company's instrumented test cars, which were used some years ago by a sub-committee of the A. A. R. Car Construction Committee in its study of the comparative riding qualities of various types of non-harmonic bolster spring groups.

The company is now offering a high-speed truck capable of safe operation at speeds up to at least 90 m.p.h. and basically a development from and a refinement of the double-truss spring-plankless self-aligning integral-box truck now in service under or on order for about 50,000 cars. The column and bolster end construction is of the characteristic self-aligning design which permits the temporary lead of one side frame over the other on entering curves and a prompt restoration to normal on leaving, without loss of bearing area, and therefore with a reduced rate of wear of column faces and bolsters. The bolster used is identical with that for the spring-plankless self-aligning integral-box truck. The bolster spring group may be of the preferred "coil-elliptic" type or any combination of coils with an efficient snubber.



Symington-Gould double-truss high-speed truck

To obtain the necessary further improvement in riding quality and safety, through prompter equalization of wheel loads at speeds in excess of 60 m.p.h., and to protect the side frames against direct rail shocks, separate boxes are used, each supporting one end of the side frame on a parallel spring group consisting of one semi-elliptic spring mounted on the box roof and two helical coil springs mounted on journal-box side brackets. This group has a total travel of 1-5/8 in., thereby doubling the total spring travel between rail and center plate with a sevenfold improvement in riding quality over that of the integral-box truck with non-harmonic spring groups, as determined by the A. A. R. method of test. The semi-elliptic springs are completely enclosed within the side-frame ends except for inspection holes and the normal

(*Continued on page 15*)

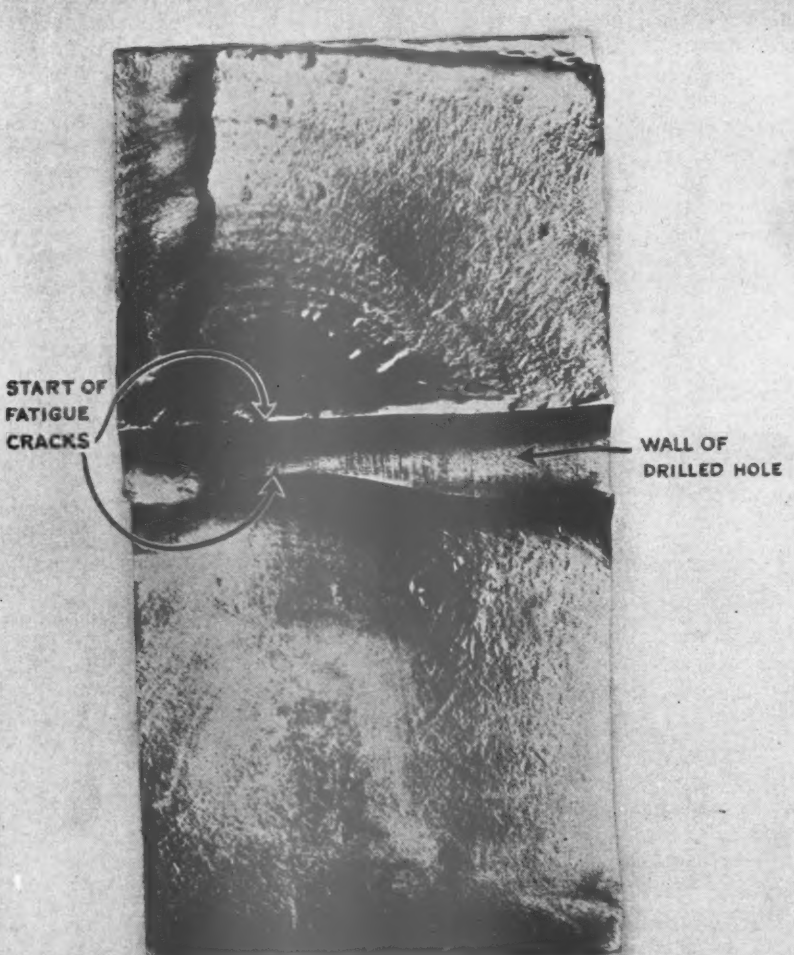


FIG. 1

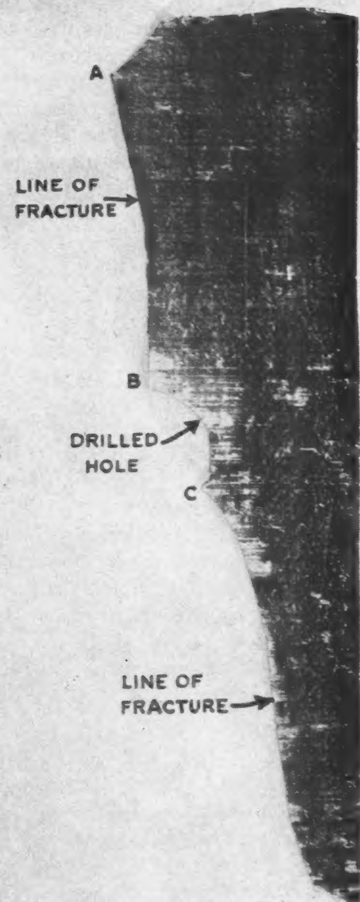


FIG. 2

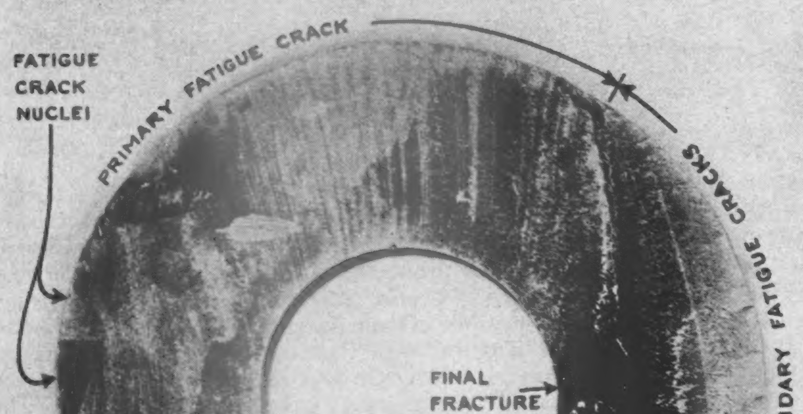


FIG. 3

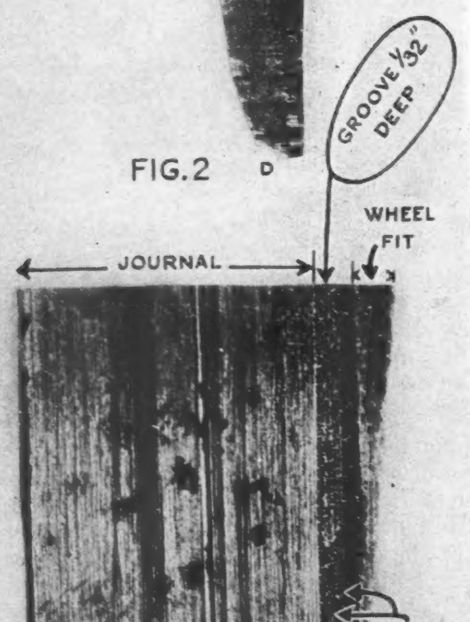


FIG. 4

Failures of

Locomotive and Car Parts

By
Frederick H. Williams, M. Sc., F.R.S.A.

THIS article considers several special types of failures of locomotive and car parts, rounding out and supplementing material presented in previous articles of the series.

Drilling Steel Parts

In considering the failure of locomotive parts because of poor machining, special attention may well be directed to the importance of the proper drilling of steel parts. An instance in which an engine frame failed because a drill was not cutting clean and tore the surface of the walls of the drilled hole, is illustrated in Figs. 1 and 2. The rough and badly torn surface from which the fatigue cracks started is clearly evident in Fig. 1. The surface of the fracture indicates that there were two fatigue cracks, both of which started from the drilled surface. It is hard to imagine that there could be much flexing of the steel in such a large cross section. The frame at the break was five inches wide and much deeper, and yet there was sufficient flexure in the mid-section, through which the bolt hole passed, to start the fatigue cracks. It at least indicates how little flexing is required to start a crack where conditions are such that the stresses can be concentrated on rough and torn surfaces.

A side view of part of the broken frame, Fig. 2, shows

Fig. 1—Surface of fracture of broken engine frame; fatigue cracks veloped from the torn surface of the drilled hole. Fig. 2—Side view broken engine frame shown in Fig. 1. Fig. 3—Fractured surface of comotive axle which failed in service; the cracks started in a rough dercutting adjacent to the wheel fit. Fig. 4—Side view of part of the oken locomotive axle shown in Fig. 3; note the deep tool marks in e section between the journal and the wheel fit.

the course of the break—almost straight upward from the top of the hole in one instance, and diagonally downward from the side of the hole in the other. A study of these two photographs, and particularly of the surface of the break in Fig. 1, would seem to indicate that the fatigue crack at the top started first and was well advanced or completed before the one at the bottom started. This insance of the failure of a large part, taken in conqunction with previous articles in this series, when similar breaks were illustrated on much smaller sections, indicates that no part of a locomotive, subject to reverse stresses, is free from possibilities of failure if the machined surfaces are rough or scored.

The economical operation of a locomotive depends upon its utilization in service, and unnecessary days spent in the roundhouse or shops for repairs detract just so much from its value to the company. It is, of course, true that one may make a fetish of smooth and polished surfaces, and yet such failures as have been described in this series of articles indicates conclusively that smooth finishes, with proper fillets and rounded corners, are an important factor in insuring long and useful life, particularly of parts subject to reverse stresses.

Locomotive Axles

Failures of locomotive axles were considered in a previous article*, but a recent failure is a bit unusual and worthy of consideration. The fractured end of the axle in question is shown in Fig. 3. It is quite apparent that several fatigue cracks around a considerable part of the circumference, finally joined together and caused the failure. Apparently, however, the quality of the steel was so excellent that the cracks extended over practically 90 per cent of the section before the break occurred. A certain amount of satisfaction can be derived from the fact that the material so stubbornly resisted the stresses and finally gave way only when a very small portion remained intact.

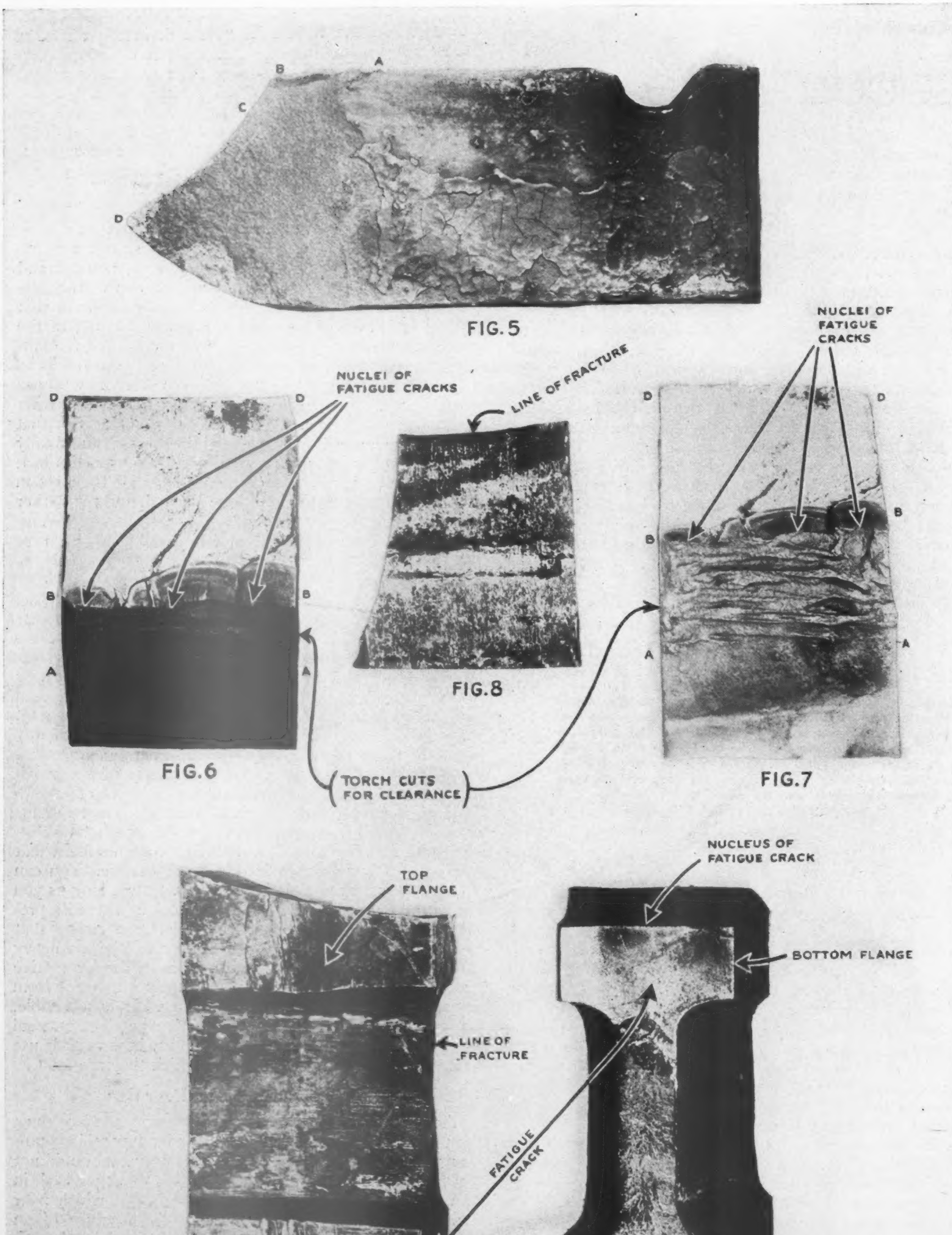
A side view of a section of the broken axle is shown in Fig. 4. The part at the left is the journal, and the darker part at the right and joining the journal to the wheel fit, is a groove or gutter about $\frac{1}{32}$ in. deep. Such a gutter $\frac{1}{64}$ in. deep would have caused a failure. This one, at least twice as deep, was rather rough cut with two rather deep tool marks in it. The fatigue crack at the lower part of the fractured edge followed one of the tool marks for about 12 in., most of the nuclei of the fatigue cracks occurring within this section. Since the undercutting was done deliberately, there must have been some reason or objective for so doing, but certainly it should have been smooth finished, without score marks or tool marks. Most of us have seen piston rods, undercut in this way adjacent to the taper fit, which have lasted the entire lifetime of the rod, because of being properly finished. Indeed, sometimes such an undercutting is so deep that subsequent turnings of the shank of the rod do not call for a new fillet, and yet they have proved satisfactory.

Manufacturers of parts which fail sometimes insist that the failures were caused by too much flexure. You can flex a steel part indefinitely, however, just as long as you do not allow the stresses to concentrate and exceed a predetermined load. If we make the parts so strong that there will be little if any flexure, they will be too heavy to be of any use. Reduction in weight of the locomotive and its parts to a minimum is extremely important from the standpoint of operating efficiency. It is advisable, therefore, that the finishing of such parts be given unusual consideration, in order to insure the very best possible use from the materials and designs of which they are built.

Improperly Cut Equalizer Bar

Acetylene cutting has marked advantages. Care must be taken, however, to use it only under favorable conditions. Carelessness on the part of the operator should not be tolerated and unusual care should be exercised in hurried or rush operations. An instance in which poor work was done, which resulted in the fracture of an equalizer bar of a baggage car, is illustrated in Figs. 5, 6 and 7. The bar did not fit properly in place and a portion of it (*a-b*, Fig. 5) was cut away with an acetylene torch. Fatigue cracks started in the burned and rough surface at *b*; these cracks extended from *b* to *c* before the rest of the section from *c* to *d* finally gave way. The

* *Railway Mechanical Engineer*, January, 1938, page 15.


A
B
C
D
FIG. 5
NUCLEI OF
FATIGUE CRACKS
LINE OF FRACTURE
NUCLEI OF
FATIGUE
CRACKS
D D
B B
A A
FIG.6
FIG.8
D D
B B
A A
FIG.7
TORCH CUTS
FOR CLEARANCE
TOP
FLANGE
LINE OF
FRACTURE
FATIGUE
CRACK
NUCLEUS OF
FATIGUE CRACK
BOTTOM FLANGE
FIG. 9
FIG.10

bar was made of steel and the molten metal cooled in such a way as to leave a hard brittle surface, readily susceptible to the starting and developing of fatigue cracks. Figs. 6 and 7 show the fractured surfaces, as well as the rough surface from which the fatigue cracks started.

The cutting of carbon steel, when the carbon content is over 15 per cent, is attended with danger and the higher the carbon content, the greater the danger. The cutting of steel changes the structure of the material and sets up strains, making heat treatment necessary. Plain annealing is ordinarily used in treating side rods which have been cut to shape; but to insure good results, the steel is generally preheated to about 1,200 deg. F. before the cutting, and the cutting is done while the steel is hot.

Fig. 5—Side view of part of a broken baggage car equalizer bar; material was cut off between A and B by an acetylene torch, apparently to provide proper clearance. Figs. 6 and 7—Fractured surfaces of broken equalizer bar, showing the development of the fatigue cracks; also the rough surface left by the cutting torch. Fig. 8—Partial view of top of fractured side rod, showing rough surface caused by gripping jaws used in lengthening the rod. Figs. 9 and 10—Views of fractured side rod, part of which is shown in Fig. 8.

Side Rod Failure

A form of failure of a side rod which is quite common, is illustrated in Figs. 8, 9 and 10. Side rods are sometimes elongated by heating and stretching them in a machine which grips the rod near the ends. The gripping jaws are likely to make dents in the rod, from which fatigue cracks may start. Such a deformation is illustrated in the partial view of a side rod shown in Fig. 8. Side and end views of the fracture are shown in Figs. 9 and 10. Incidentally, if the fracture had not started where it did, other bad deformations which are quite apparent in Fig. 9 would surely have caused trouble. Obviously the surface of the rod should have been refinished after the length was adjusted, and the scars and dents removed.

The rather miscellaneous series of failures which are pictured in this article illustrate clearly the necessity of greater care in performing the ordinary operations of repair work in railroad shops; not only this, but they emphasize the necessity for careful and critical inspection of all repair work, and particularly of those parts which are subjected to alternate stresses.

Anderson Spark Eliminator

After several years of experimenting on the Chicago, Milwaukee, St. Paul & Pacific with various styles of Anderson spark eliminators, also known as arresters, the open-type, shown in one of the illustrations, has been adopted and about 150 of these are now in service in both freight and passenger locomotives on the Milwaukee.

The thirty 4-8-4 heavy combination freight and passenger locomotives, recently delivered by the Baldwin Locomotive Works, also have these spark eliminators and the six 4-6-4 streamlined passenger locomotives, delivered to the Milwaukee this fall by the American Locomotive Company, are equipped with the same device.

Many difficulties were encountered and eventually overcome during the process of development, the main problem being to obtain free-steaming locomotives and yet not throw sparks from the stacks. With ordinary bituminous coal this would be a relatively easy matter, but in the territories where semi-lignite is burned the elimination of sparks is a serious problem. However, the Anderson open-type spark eliminator which was finally developed and adopted is said to be giving highly satisfactory results as evidenced by extensive service tests on the Milwaukee and by a joint report of the state forestry inspectors of Wisconsin and Minnesota after they had made several observation trips in the cupola of a caboose immediately behind a locomotive equipped with this style of arrester. During these tests, wooden planks and chips were thrown into the firebox,

Fig. 1—One of the earlier styles of Anderson spark eliminator with a portion of the front section removed

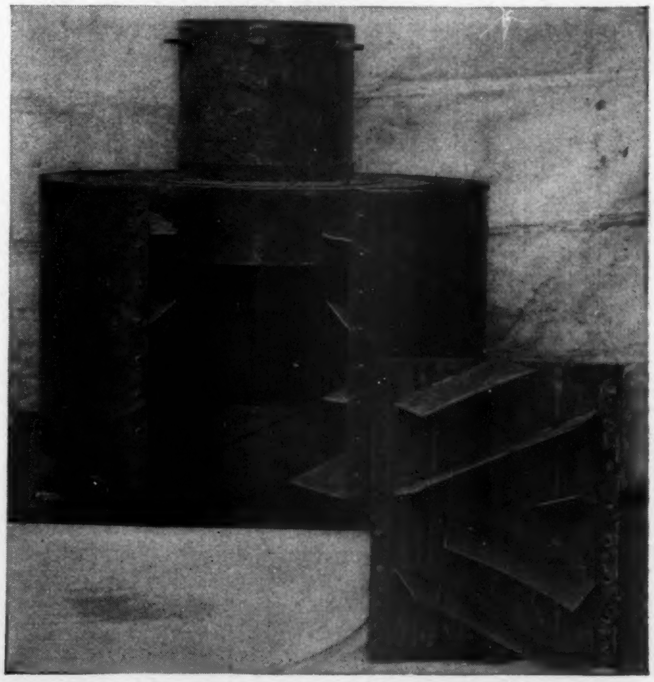


Fig. 2—Anderson closed-type spark eliminator with front section removed

but it is reported that even with such a severe test no sparks came out of the stack.

Other arresters were developed on the Milwaukee besides those illustrated, all of which are fully covered by patents, but those immediately preceding the present open-type arrester are shown in Figs. 1 and 2. That shown in Fig. 1 had both an inner and outer arrester, with numerous vanes for eliminating the sparks. This style was abandoned after the type shown in Fig. 2 was developed due to the expense of manufacture and maintenance, and having to remove it from the front end whenever work was required on the units and flues. As can be seen in Fig. 2, this type of spark eliminator had a door to facilitate work on the nozzle and arrester. This also had to be removed when it became necessary to do any work on units and flues. This style was discontinued after the open-type eliminator with a tapered inside stack, as shown in Fig. 3, was developed.

Referring to Fig. 3, the essential part of the open-type eliminator is the vertical vanes that are set at a specified angle between the top and bottom plates. The surfaces of these vanes break up and eliminate the sparks. The rear portion of the table plate has apertures cut in it by making U-cuts with a torch and by bending downward and forward the metal inside these cuts. The rear edges of these apertures form

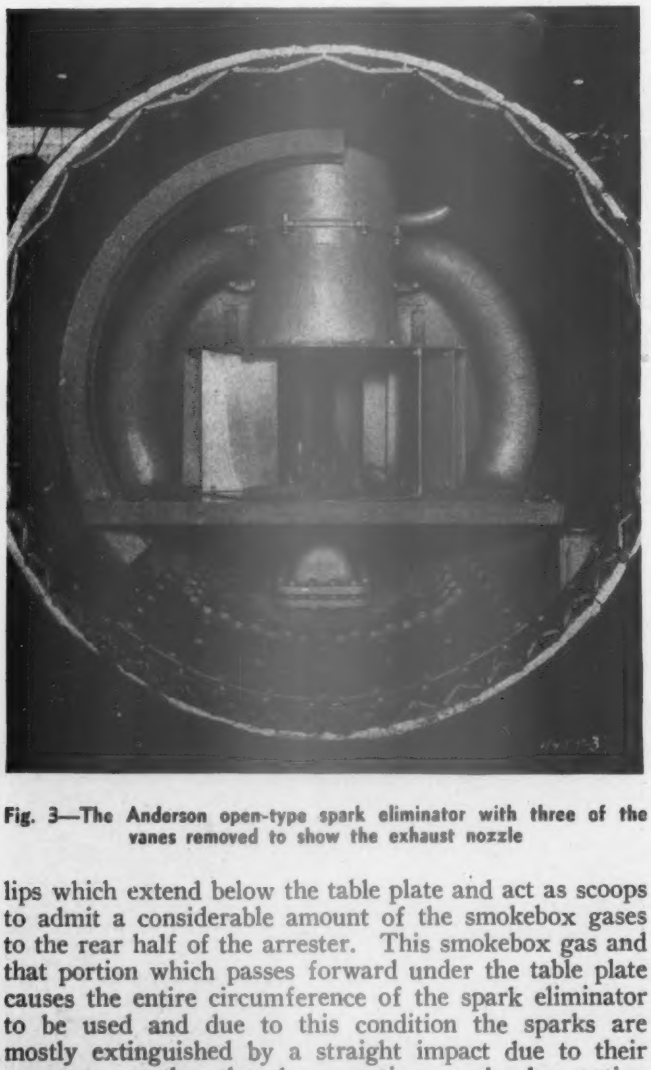


Fig. 3—The Anderson open-type spark eliminator with three of the vanes removed to show the exhaust nozzle

lips which extend below the table plate and act as scoops to admit a considerable amount of the smokebox gases to the rear half of the arrester. This smokebox gas and that portion which passes forward under the table plate causes the entire circumference of the spark eliminator to be used and due to this condition the sparks are mostly extinguished by a straight impact due to their momentum rather than by a continuous circular motion around the inside of the eliminator.

Since the outlet to the stack is at the vertical center line and the flow from all directions is towards this section, there is but little whirling action in the eliminator itself. This fact is borne out by the service secured from the vanes which would tend to be quite limited if they were set at such an angle as to give a pronounced circular motion to the incoming gases and sparks. In the course of time these vanes wear at the inner edges due to the gas passage area being considerably less here than at the outer circumference, but since all the vanes are made reversible this wear is not an objectionable feature.

The angle of the vanes and their width determine the efficiency of the eliminator. These two items of the design were determined by experiment, but are also controlled to some extent by the size of the smokebox. However, the gas area through the vanes should be more than 100 per cent of the flue area through the front tube sheet. That shown in Fig. 3 is maintained at 128 per cent of the flue area for this particular class of engine and no sparks are being thrown from the stack when bituminous coal is burned. If there were, the only change that would be necessary would be to change the width of the vanes from 14 in. to some greater distance. If the change happened to be from 14 in. to 16 in. the area through the eliminator would be reduced from 128 per cent to 108 per cent of the flue area.

In territories where a semi-lignite coal is being burned the eliminator shown in Fig. 3 is operated with vanes 18 in. wide, thereby reducing the gas area to 78 per cent. This is apparently considerably more than that obtained with netting-type front ends. Although they may be designed to give 200 per cent of the flue area, the frictional resistance that the gases have to overcome to get through the netting is high and due to their construction, large sections of the netting are not used. Moreover, the sections through which the gases pass are often half plugged with cinders that have wedged themselves into the open spaces. There also have been many instances when foaming or priming has made the exhaust steam wet and heavy enough to cause the front end netting to become plastered over sufficiently to cause steam failures. An arrester without netting or perforated sheets eliminates this potential source of trouble.

The top plate of the Anderson open-type spark eliminator shown in Fig. 3 is divided at the center line so that one-half at a time can be taken out through the smokebox door or set to one side in the smokebox when necessary to work on the units or flues. This work can also be done by unbolting and removing a few of the vanes when not necessary to remove the top plate to allow a free passage to these parts.

Although a tapered inside stack extension is shown in Fig. 3, a straight cast iron inside stack is also used and is quite satisfactory when round nozzles are employed. This style extends into the eliminator a few inches and is supported by an integral collar on its upper end which fits into a suitable recess in the stack base. It can be easily taken out by removing the main stack and pulling the extension up through the stack base. The tapered inside stack is bolted in place. A metal spacer ring rests between the top of the eliminator and the extension flange on the bottom of this style inside stack and since this ring is about 1/8 in. thicker than the telescopic joint at the top, the stack extension drops down sufficiently to clear the main stack when the ring is removed. In this way, this style of inside stack extension can be removed and passed through the smokebox door without removing any part of the eliminator.

This spark eliminator is being used successfully with prong, choke-bore, plain-bore and annular-ported nozzles. It has also brought about the general use of increased

(Continued on page 15)

Production Methods Used in Construction of

Milwaukee Welded Flat Cars

New 50-ton cars embody unit principle of construction and are designed to accommodate loads which are both heavy and bulky

In the construction of 500 all-welded flat cars now in progress at the Milwaukee shops of the Chicago, Milwaukee, St. Paul & Pacific, the principle of unit construction is utilized to fabricate the various parts of the cars before the assembly operations are carried out. This principle has been utilized in previous car construction programs on the Milwaukee. In accordance with the practice of that road in building new cars, separate jigs are used for the fabrication of such individual parts as bolsters, cross-bearers, center-sill sections and end sills. After the fabrication of these individual units, they move to an assembly line where the various units are welded together to make up the final steel assembly. In subsequent positions, couplers, draft gears and air-brake equipment are applied. The trucks are assembled separately.

The present series of cars, the construction of which is described in the article, are 52 ft. 6 in. long over the end sills, 53 ft. 3 in. over the striking castings; have a capacity of 50 tons; and weight approximately 45,600 lb.

In the development of this flat car, the principal objectives have been to adhere to Association of American Railroad standards; conform to loading requirements; provide minimum initial and operating costs; and meet, as nearly as possible, shippers' requirements for this class of equipment. The unusually large deck, 52 ft. 6 in. long by 10 ft. 6 in. wide, is especially advantageous to manufacturers who desire to ship tractors, threshers and similar equipment requiring maximum-width cars.

The car has been designed from a welding standpoint throughout, using ordinary low-carbon steel, and stresses have been computed with a relatively high factor of safety. Standard mill sections, plates and bars with standard mill tolerances are employed and these have a definite bearing on cost reduction.

Owing to the substantial thickness of the plates used in the car, it has been necessary to use ¼-in. and 5/16-in. welding rods except in isolated parts where 3/16-in. is used. The majority of the welding is intermittent with a ratio of 1:1 except in the region of the bolsters. Here, continuous welding is carried out using fillets of ¼ in. Both transformer-type and motor-generator-type welding machines are being used.

Fabrication of the Principal Structural Units

The center sills consist of two built-up sections, each comprising a web plate (cut to fish-belly shape), one upper chord angle and two lower chord angles. Each section is built up on a jig accommodating two, one of which is being set up while the other is being welded. This gives a high operating factor; i.e., per cent of time the arc is in operation; and since the majority of the welding is in a downhand position, maximum efficiency results. The completed sections are delivered by an overhead crane direct to the center-sill assembly jig. Here they are welded to a top cover plate while center-sill spreaders are welded on, center-filler and striking castings riveted in place and couplers and draft gears applied. This jig accommodates two such set-ups to cut idle time to a minimum.

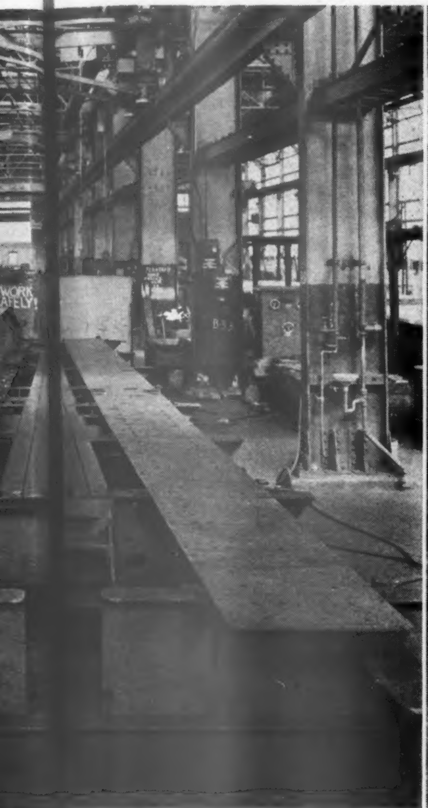
Each side sill consists of a web plate (cut to fish-belly shape), one lower chord angle and a top cover plate. These are welded together on a jig built to take two such assemblies, and the 15 stake pockets are then welded to each sill.

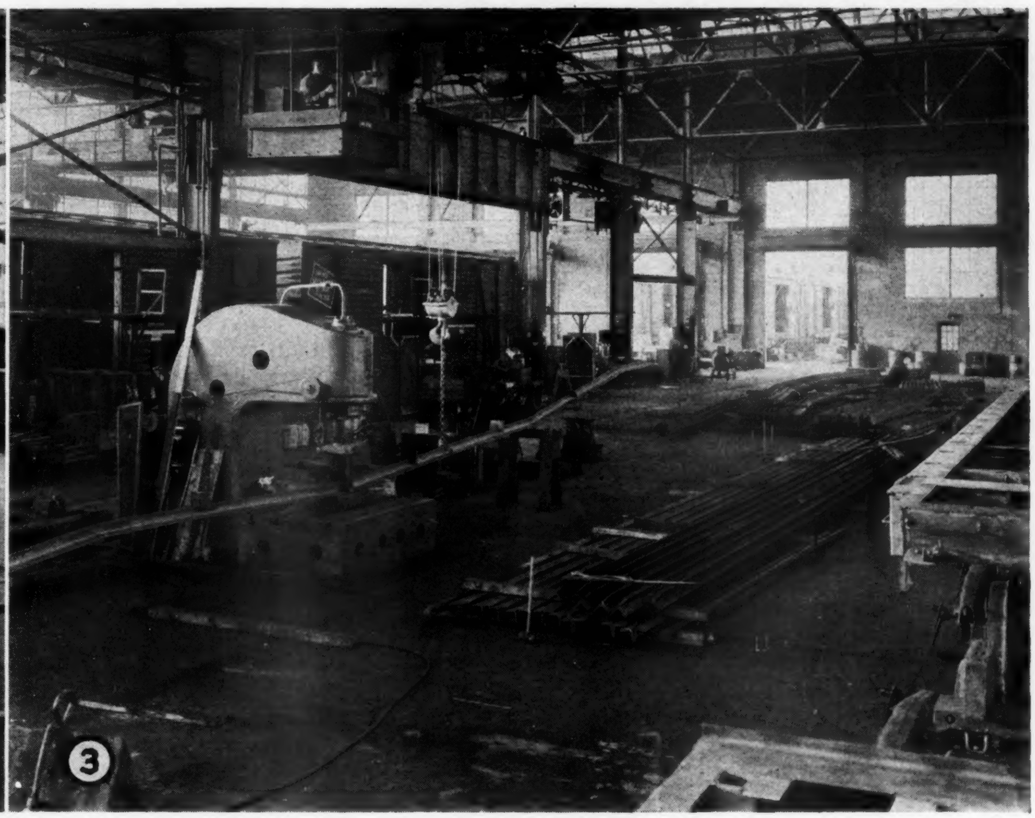
(Continued on page 14)

Milwaukee 50-ton flat car just out of the shops

Milwaukee Welded Flat Cars

(1) The trucks are assembled at a location especially equipped for the job. (2) The center sills consist of two sections, each built up on a jig which accommodates two; one being set up while the other is being welded. (3) At this position the chord angles are being formed in a hydraulic press





Milwaukee Welded Flat Cars

(4) The end sills are made up of two channels welded to a cover plate. This view shows an A-end sill in the revolving jig. (5) The jig used for fabricating body bolsters is also of the revolving type. (6) A group of B-end sills which have just been removed from the welding jig, shown in the background

Portable flame cutting machine used on tapered sections

Each end sill is composed of two channels which, in turn, are welded to a cover plate. This is accomplished in a revolving jig so that all welding is positioned. Grab irons, uncoupling castings and hand brakes are riveted on by means of a power riveter before the two parts are welded to the cover plate. This eliminates hand riveting and adds to the general efficiency. Separate jigs for the A and the B end sill are provided.

The bolster center-filler casting is a built-up, welded assembly, in which the center-plate casting is welded in place by means of tie-plates which, in turn, are welded to the forged bolster spider sides. This is likewise accomplished in a revolving jig.

The cross-bearers are web plates welded to top and bottom cover plates. Each cross-bearer is assembled in two units on a specially constructed table. One unit consists of a continuous top cover plate, web plate and bottom cover plate while the other has the web plate and bottom cover plate only. In the final assembly the top cover plate passes through slots in the center-sill web plates and is welded in place. The bottom cover plates are welded directly to the center sills and, in order to make them continuous, a tie-plate is welded to the center sills across the lower chord angles.

Each bolster consists of two web plates, one top cover plate and one bottom cover plate. Between the web plates and welded to the bottom cover plate is the H-beam or side-bearing brace. A top cover plate is applied in the main assembly jig. Two revolving jigs are used.

All individual units, having been manufactured, are taken to an assembly jig. The completed center sill is set up with the bolsters, cross-bearers, cross-ties, end sills and side sills and these parts are welded together into a single unit. During the welding operation, the side sills are held in place by means of eight air cylinders—four on each side of the assembly jig. The unit underframe, which is in an upside-down position, is then moved to the next jig where the piping and air-brake parts are applied.

After the welds have been peened and brushed, the car is placed right-side-up; put on trucks, and shunted into the paint booth for the initial priming coat. The latter is a quick drying paint with chromate base. From the paint booth, the car is moved to the adjacent track where car cement, on surfaces having metal and wood contact, floor stringers and boards are applied.

Select common fir is used for floor and stringers, while rough lumber 3 in. by 10 in., with milling sufficient only to surface and square the boards, is used for the flooring. To hold the latter in place there are six ½-in. flat head carriage bolts and four No. 4, 5½-in. long steel wire nails per board. After the floors are applied, the cars are moved to the spray booth where they receive two coats of quick-drying freight-car paint. The final operation is application of the stencils and rigid inspection.

In addition to the usual forged parts manufactured at Milwaukee shops, the following are also locally made: spring planks, spring plates, brake beams, wheels, brake shoes, thrust plates and brake-lever badge plates. The taper section of the web plates on side and center sills is shaped by the use of a portable motor-driven oxy-acetylene cutting machine. The chord angles are cold-formed in a press.

Partial List of Equipment Used on New Milwaukee 50-Ton Flat Cars

Air brakes	Westinghouse Air Brake Co., Wilmerding, Pa.
Brake-beam safety support	Chicago Railway Equipment Co., Chicago
Hand brakes	Superior Hand Brake Co., Chicago
Bottom-rod support	Chicago Railway Equipment Co., Chicago
A.A.R. Type E rotary couplers	Buckeye Steel Castings Co., Columbus, Ohio
Coupler release rigging	Standard Railway Equipment Mfg. Co., Chicago
Cast-steel coupler yokes	Buckeye Steel Castings Co., Columbus, Ohio
Defect-card holder	Apex Railway Products Co., Chicago
Draft gears	Cardwell Westinghouse Co., Chicago Waugh Equipment Co., New York Edgewater Steel Co., Pittsburgh, Pa. National Malleable & Steel Castings Co., Cleveland, Ohio W. H. Miner, Inc., Chicago
Dust guard and closure	Holley Wood Products Corp., Chicago
Journal-box lids	Motor Wheel Corp., Lansing, Mich.
Journal brasses	Magnus Metal Corp., Chicago
Journal wedge	Standard Forgings Corp., Chicago
Side bearing	Edwin S. Woods & Co., Chicago
Side-bearing wedge	American Car & Foundry Co., New York
Truck side frames and bolsters	Bettendorf Company, Bettendorf, Iowa
Barber truck stabilizer	Standard Car Truck Co., Chicago

Underframes are assembled upside down

Modified Freight Truck For High-Speed Service

(*Continued from page 5*)

open space within the side-frame compression and tension members, but all these openings can be closed when specified for more complete protection of the semi-elliptic springs. These springs are entered and removed through the open ends of the side frames, and gasketed covers keep these end openings dust- and water-tight in service.

The side-frame pedestal jaws and the journal-box pedestal ways are contoured as segments of concentric circles, carefully gaged to limits of close clearance. The journal box is, therefore, capable of the same partially rotative movements, between the pedestal jaws as is the bolster and within the columns, thereby making the truck self-aligning throughout and providing the same design essential of full bearing area as is present in the self-aligning column and bolster construction. The pedestal

The ball-joint journal box and parallel spring group

jaws, pedestal ways, column faces and bolster ends may be equipped with hardened liners when specified.

The partial rotation of the journal boxes in response to angular movement of the axles is facilitated by the rocker end mounting of the helical springs, the upper and lower spring caps being contoured to permit an easy rocking motion with minimum frictional resistance to angling and to assist in restoration of the boxes to normal position.

The usual internal box clearances are maintained and (in the absence of lateral axle shock) these permit a limited amount of angling of axle, bearing and wedge without box rotation, but under these conditions only one journal-bearing side lug and one corner of the wedge can be in contact with their respective stops within the journal box. Under simultaneous lateral axle movement, the self-aligning journal box immediately rotates so that both journal-bearing side lugs or both front corners of the wedge are brought into contact with the internal stops, thereby avoiding any battering or breakage of the side lugs, any non-cylindrical wear of the journal-bearing lining or any lift of the bearing to invite waste grabs. The usual flat side pedestal type box is not designed to angle with the axle and such angling as pedestal clearance might permit is not sufficient to protect the bearing against damage from lateral axle thrust.

In the truck herein described proper relative alignment of the two side frames is maintained by means of a pin-connected transverse bottom tie. The side frames may be used without change with a two-piece lateral-motion bolster consisting of a transom bolster supported in the usual manner on the preferred spring groups, and a floating short bolster resting on suitable contoured and geared rockers seated in pockets in the transom bolster. The frames can also be furnished for use with clasp brakes when specified

Standard equipment for this truck includes constant-contact, resilient and non-harmonic side bearings, as the road tests mentioned herein have proved the desirability of bearings of this type to prevent synchronous car-body roll, truck nosing and undue lateral oscillation The first is unavoidable at high speeds with side bearings maintaining the usual clearance. With the type recommended the car body is constantly stabilized but with sufficient resilient yield of the truck bearings to meet all track conditions without danger of derailment.

Anderson Locomotive Spark Eliminator

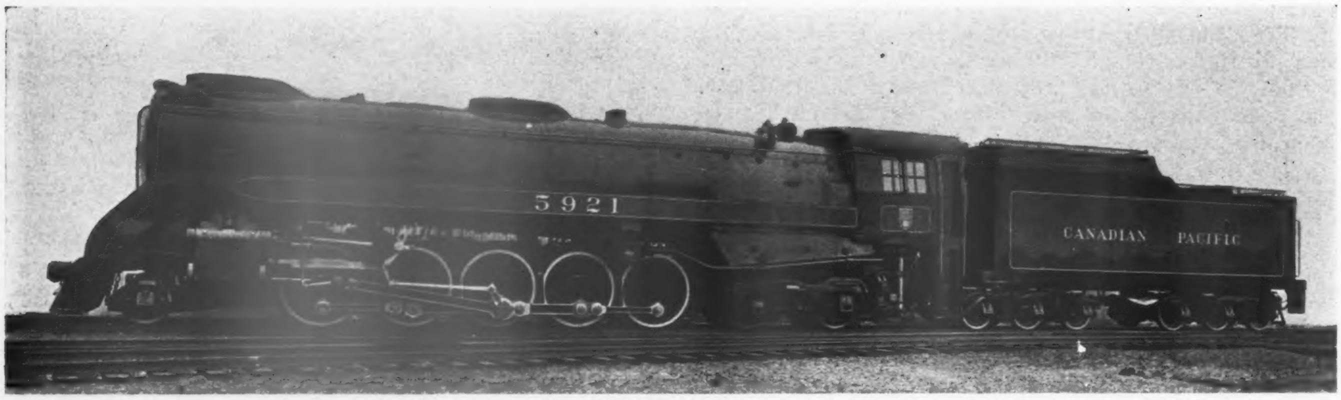
(*Continued from page 10*)

nozzle areas and larger stacks. In some instances the stack areas are said to have been increased 49 per cent and the nozzle area 30 per cent. This increase in nozzle area is for the same style of nozzle, but when the annular-ported nozzle was substituted, as happened in many instances, the increase was greater than 30 per cent.

Although the application of the Anderson open-type spark eliminator has made a considerable improvement in locomotive performance, the primary effort back of all the experimental work was to reduce the amount of money spent in settling fire claims and fire-loss damages to both railroad and privately owned property. The results obtained in this respect have been highly gratifying. It is reported that, on one division alone, with 535 miles of main line on which the only coal burned is a semi-lignite, the average loss due to fires caused by locomotive sparks was approximately $22,000 per year over about a 10-year period. During the four-year period that the present spark eliminator has been used through this same territory no money has been spent to settle fire claims.

THE "IRON HORSE" A HEAVY DRINKER.—Approximately 600 billion gallons of water are required annually to quench the thirst of the "Iron Horse" and for other purposes in connection with the operation of the railroad systems of this country, according to the Association of American Railroads. This quantity of water, the A. A. R. statement says, would be sufficient to meet the needs of the inhabitants of New York City for two years, or a city the size of Washington, D. C., for seventeen years. In volume and weight, the quantity of water used by the railroads each year is greater than all other materials combined. In order to provide the kind of water necessary to meet their needs, the railroads spend approximately $50,000,000 each year. The cost of replacing their 18,000 existing water stations would be in excess of $400,000,000. More than one-half of the water required is used for steam purposes. By the chemical treatment of this water to remove harmful ingredients which cause rust and scale to form on the inside of locomotive boilers, the railroads "have brought about increased safety and efficiency in operation as well as a saving of millions of dollars annually."

1938 Equipment

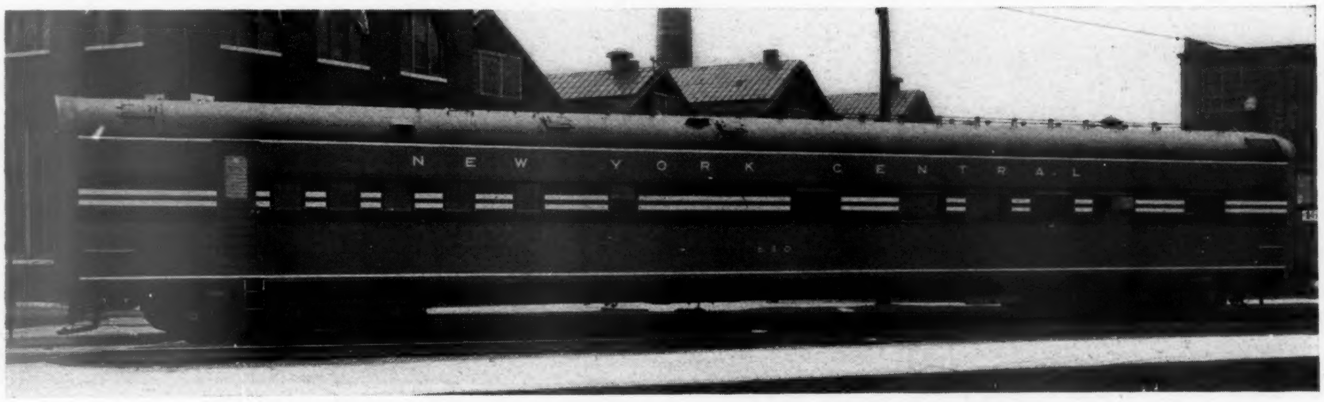


The Canadian Pacific's 2-10-4 type oil-burning locomotives built by the Montreal Locomotive Works for Rocky Mountain service. Tractive force 90,000 lb. Designed to handle 1,050 tons on a 2.2 per cent grade

A 900-hp. Diesel-electric switcher built by the American Locomotive Company for the Warrior River Terminal

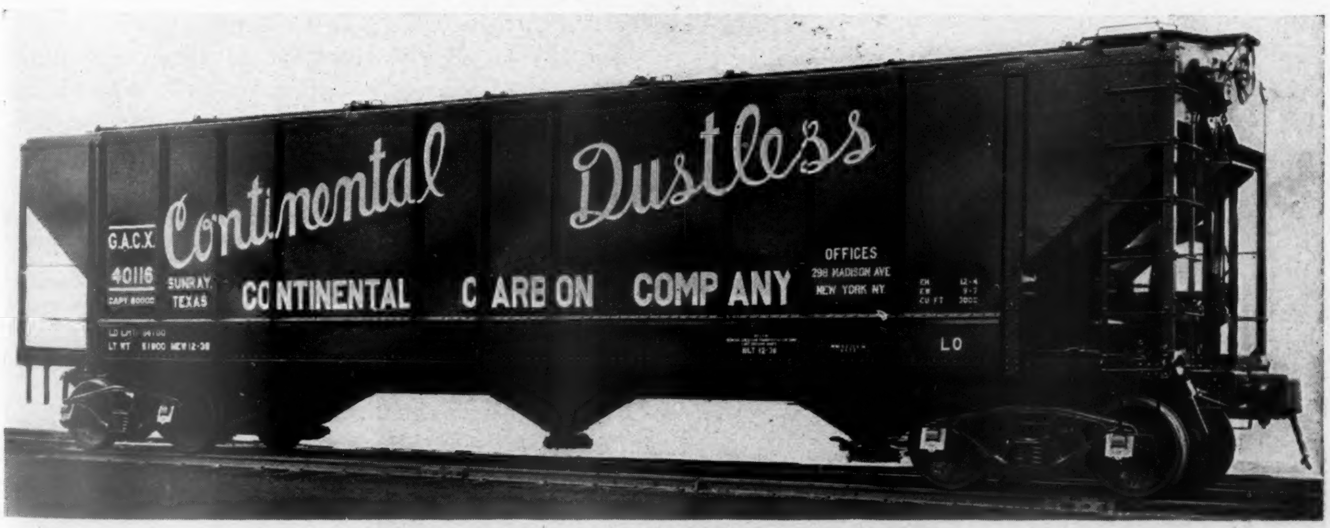
6,000-hp. Diesel-electric locomotive built for the Seaboard Air Line "Orange Blossom Special" by the Electro Motive Corporation

1938 Equipment



Dining car built by Pullman-Standard Car Manufacturing Company for service on the New York Central "Twentieth Century Limited"—Total weight 134,300 lb.

Furniture car built for the Southern by the Mt. Vernon Car Manufacturing Company



Covered hopper car built for the Continental Carbon Company by the General American Transportation Corporation

1938 Equipment

Light weight deluxe coach built for the New York Central by the Edward G. Budd Manufacturing Co.

50-ton twin-hopper car built for the Canadian Pacific by the National Steel Car Corporation

Six locomotives of this 4-8-2 type were built for fast passenger service on the Grand Trunk Western by the Lima Locomotive Works—the weight of the engine in working order is 382,700 lb. and the tractive force 52,500 lb.

EDITORIALS

Subscribers, Attention!

Another index is now ready for distribution. Subscribers not on our mailing list for the 1937 index are requested to send us their names and addresses promptly if they wish to have this detailed record of the material published in the twelve issues of the *Railway Mechanical Engineer* for 1938.

Significant Changes In Equipment

At the turn of the year it has become customary to pause for a look backward at the course of events during the year that has just closed in order to correct reckonings and, if necessary, reshape a course for the future. In such matters as the design of railway motive power and rolling stock, trends seldom show themselves clearly within the duration of a single year. Looking a little further back, however, significant changes are clearly apparent which are making all equipment—locomotives, passenger cars and freight cars—quite different operating instruments from those which today make up by far the majority of the units in service.

There are three significant factors in these changes. First, is the use of improved materials. This applies not alone to the new structural materials which are going into the building of passenger and freight cars, but to locomotive materials as well. The use of alloy boiler steels has become well established, although far from a majority of the locomotives in service today are fitted with boilers in the construction of which such materials were used. Alloy steels for locomotive forgings have been available for many years. When first applied, however, they were somewhat ahead of the real need for them and also ahead of the standards of practice affecting their handling in the shop. Today, they are coming back into successful use. The higher speeds to which motive power, both for passenger and freight service, is being more and more subjected and the demand for reduced maintenance require the improved physical characteristics of these materials and more intelligence is being applied in dealing with them in the shop.

A second factor, in a measure at least, is related both as cause and effect, to the first. Cars and locomotives are no longer being fitted by 2-ft. rule, but in all working fits tolerances are being reduced until they are becoming more and more of the order established in the automotive industry. Modern American locomotives are no longer being worn out before they run their first mile, and the combination of refinements of design, such as those involved in the use of roller bearings and close tolerances, is beginning to play a definite part in prolonging the service life of motive power particularly and, to some extent, passenger cars also.

Closely related with these two factors is a third—a gradual refinement of shop practice. This perhaps, is less an accomplished fact than the other two factors, and its contribution to improvement in reliability and low maintenance cost is largely to be effected in the future. The use of alloy steels, for instance, demands much more careful handling in the machine shop than has long been tolerated in dealing with carbon-steel parts. Although the better practice will be essential with the alloy materials, it is proving of great value in prolonging the life of carbon-steel parts, the failures of which have been found to result directly from rough treatment. The hammer and chisel era must pass, to be replaced by precision tools and a precision psychology.

The Present Equipment Situation

As the year 1939 gets under way there are many promising signs for much better business than existed during the early part of 1938. The downward trend of general business which began in the fall of 1937 continued until May, 1938, and from that time on there has been a steady improvement in most of the business indices, including railway carloadings and revenues.

With the prospect for a continued increase in the volume of general business activities, at least during the first half of 1939, it is significant that the declining supply of motive power and freight cars is rapidly reaching the point where it provides little reserve capacity to meet increased business. Furthermore, the entire inventory of rolling stock is characterized by high obsolescence.

In the case of locomotives obsolescence has been steadily increasing since the beginning of the depres-

sion in 1930. Although retirements have kept up well, installations of new locomotives have been exceedingly low. In the nine years 1930-38, inclusive, only about 1,900 new locomotives have been added to the inventory. During the same period, however, the retirements have been over 15,500. At the end of 1933 there were 30,500 locomotives—60 per cent of the total—which were 19 years of age or over. Five years later, at the end of 1938, 30,600 locomotives, or 70 per cent of the present total, were 19 years of age or older. Almost one third of all the locomotives are 29 years of age or older. Less than 5 per cent of the present inventory are under 10 years old.

The present supply of freight motive power is probably incapable of successfully handling a volume of traffic as much as 10 per cent higher than that of 1937.

Much the same situation as to age applies to freight cars as has been pointed out with respect to locomotives. For the seven years 1932-38, inclusive, there has been an average of 80,000 freight cars permanently retired from service each year and an average of 22,000 new units acquired. Thus, there has been a steady reduction in the total number of cars, but retirements have scarcely been enough to keep up with the increasing average age of the remainder of the inventory and the new acquisitions at the top have been too small to change the situation appreciably.

The present freight-car supply has reached a point where it is probably adequate to handle a fall peak averaging about 850,000 to 860,000 carloads per week during the highest four weeks' period. This represents an increase of less than four per cent above the peak attained in the fall of 1937. The realization of the narrowing margin of freight-car capacity is indicated by the fact that retirements during 1937 and 1938 have been considerably below the average for the past eight years, amounting to about 69,000 in 1937 and 43,000 last year. Extensive further retirements must be accompanied by replacements of at least as many cars as, and with a continuance of the present traffic prospects many more cars than, the number retired. The incentive for further retirements when there is a restoration of net railway operating income has been increased during the past few years with the gradual establishment of the technique of lightweight construction using high-tensile steels and fabrication by welding. New brakes and developments improving the riding qualities of trucks are also factors which are increasing the obsolescence of the older equipment.

Stream-styled lightweight passenger trains increased during 1938 at an accelerating rate. Thirty-one new trains of such equipment operating on expedited schedules were introduced last year as compared with a total of 54 such trains during the preceding four years. Lightweight cars are also gradually replacing cars of older construction in many other trains.

The demand for artistically finished and decorated passenger-car interiors has been thoroughly established. Few new cars are now built which do not reflect the work of the skilled decorator, in many cases on the exterior as well as on the interior. New methods of lighting, air conditioning, seats designed primarily for the comfort of the occupants and de luxe toilet and lounge facilities are all features of modern passenger-train cars which make the older coaches, many of which are thoroughly sound structures, obsolete from the service standpoint. Rehabilitation projects are restoring some of this older equipment to satisfactory units from the standpoint of the patrons. But all indications point to a steady expansion in the building of cars of light weight, which the new structural materials make possible.

Shop Needs Increase With Better Business

As we look forward to the prospects of railroad operation during the coming year, we are faced with the fact that the demand upon the car and locomotive maintenance facilities will probably increase greatly with the anticipated increase in traffic. In spite of the fact that there has been a substantial increase in car loadings over a period of several months it is true that shop operations as yet have not been stepped up to as great an extent as may seem to be warranted. We have had sufficient experience in this country over a period of ten years with necessarily limited railway repair operations as a result of business depression to know that the economies that are necessary in order to assure the solvency of railroad corporations usually result in conditions that contribute to higher unit costs in the maintenance of equipment. We have long since learned that preventive maintenance is the most economical in the long run, in that it enables a railroad company to keep its motive power and rolling stock in a better average condition. Where intelligent programs of preventive maintenance can be carried out, the unit costs of maintenance—per locomotive- or car-mile, for example—are usually lower than is the case where repair work must, of necessity, be carried on in a more or less hand-to-mouth manner. In locomotive repair work particularly, the cost of maintenance is to a large extent influenced by the relation of the design of motive power to the maintenance problem and to the character of the facilities with which power is maintained.

As a result of the curtailment in purchases of both motive power and shop equipment during 1938, the needs in railroad shop equipment during 1939 are probably going to be more severely evident than they were in 1937 when the volume of traffic exceeded 800,000 cars a week. In view of the fact that the installations of new shop equipment in any one of the last several years, with the possible exception of 1937, have not kept pace with the retirement of obsolete units, there is every indication, as things stand now,

that many roads will find themselves in the position of facing rapidly increasing costs of maintenance operations as the demand for motive power and rolling stock picks up with increasing business.

An analysis of the records of railroad shop equipment purchases during 1938 indicate that there was probably less general buying done of that type of equipment than in any recent year, with the possible exception of 1932. This might satisfactorily be explained on the basis that there was as little, if not less, capital available for the purchase of this type of equipment in 1938 than there was in 1932. There is, however, a significant difference existing in relation to the two years. Because of the fact that up to 1929 and 1930 railway purchases of shop equipment had been of substantial volume for several years, it is reasonable to assume that the average shop was fairly well equipped with machine tools and shop equipment of comparatively modern types as of that date. Beginning with 1932 and continuing up to the present, the purchases of such equipment have been well below normal and many obsolete units have been retired so that it is reasonable to assume that at the end of 1938 the general condition of railway shop equipment as regards suitability for the job at hand is much less favorable than it was at the end of 1932.

Aside from any consideration of the general condition of railway shop equipment, certain things stand out as being of major importance in connection with shop facilities at this time: (1) Continued pressing demands for reductions in operating expenses increase the need for modern repair equipment that will assure low cost operations, (2) there is every evidence of a growing appreciation on the part of mechanical officers and supervisors of the value of modern cost-saving shop equipment as a result of the performance of new installations over the past two or three years, (3) as railway net operating income increases and funds again become available for capital improvements those who are interested in shop equipment must compete with other departments for a share of the money that will be expended and, with better business conditions, the speeding up of industrial and building operations, plus a practically assured broad-scale program of national defense, will undoubtedly make it extremely difficult for the railroad industry to secure new units of shop equipment at a time when it may need them the most.

Those who are responsible for maintenance of equipment operations should not overlook the fact that the prospects for future industrial operations indicate the necessity of competing with other industries, in the matter of price and delivery, for such shop equipment as will surely be needed. Now is the time to lay out comprehensive programs for the replacement of many of the obsolete units still remaining in service and prepare requests for the most important of these replacements early enough in the year to assure that installations can be made in such time that they may contribute to lower maintenance costs during the year.

New Books

LOCOMOTIVE CYCLOPEDIA. *Compiled and edited by Roy V. Wright and R. C. Augur under the supervision of an Advisory Committee of the Association of American Railroads, Mechanical Division. Published by the Simmons-Boardman Publishing Corporation, 30 Church street, New York. 1232 pages, 9 in. by 12 in., over 2600 illustrations. Price, $5 cloth bound; $7 leather bound.*

The material in the tenth edition of this work is classified in 21 sections, following the same general arrangement as that employed in the last three preceding editions. The first section constitutes the well-known Dictionary of Terms and the others deal with steam locomotives, their various details of construction and special equipment, as well as with electric locomotives, Diesel locomotives and industrial locomotives. The ninth edition was published in 1930. During the eight intervening years tremendous advances have been made in locomotive proportions as well as in the various working parts and construction details. The entire development of roller-bearing driving boxes following the notable installation on the Timken locomotive, which was shown in the preceding edition, has taken place since that edition was printed. Since then the application of roller bearings has extended to the rods as well. Locomotive types on which the four-wheel trailing trucks are used have come to predominate during this same period. In the internal combustion field emphasis has changed from the rail motor car to the locomotive, including road locomotives as well as switch engines. Because of these and other marked changes which have taken place in the last eight years, the material in the tenth edition of the Locomotive Cyclopedia is predominantly new in all sections. A notable change in the new edition has been made in the section dealing with shops and engine terminals. In recent editions of the Locomotive Cyclopedia this section has consisted largely of descriptions of facilities used in the repair of steam locomotives in back shops and enginehouses. In the new edition this section is planned to embrace a general picture of the many phases of locomotive maintenance work needed for reference by those responsible for the conduct of such work. In the 21 chapters of this section has been recorded what has been recognized as modern design and practice. There are 11 chapters which cover the work of the machine shop in detail. Other chapters deal with the forge shop, material handling, and the engine terminal. At the end of the shop section has been added a list of references to articles and reports on shop layout, operation and practice which provides a valuable guide to supplementary information on the several subjects. As a whole, improvements have been made in indexing and the sections and sub-divisions have been somewhat more clearly defined, thus facilitating the convenience of the book as a reference volume.

IN THE BACK SHOP AND ENGINEHOUSE

Gas Burners for The Railroad Shop

Natural and artificial gas can be used for nearly every shop heating operation. In the blacksmith shop gas is used in the large furnaces where scrap is worked into billets and locomotive parts forged. It is frequently used under the boilers in the power house, especially near the gas fields where a low industrial rate is obtainable. Natural gas is used to kindle the fires in coal-burning engines, and has also been used to fire up oil-burning locomotives to working pressure. The fuel lends itself readily to all common shop operations, such as lead and babbitt melting, brass melting, tire heating, preheating all sizes of castings for welding, toolroom tempering (including high-speed steel), lead or cyanide hardening, case hardening, and rivet heating.

The design of gas burners is usually left to the manufacturers, but there are several burners used in shops and enginehouses that are almost impossible to obtain. Manufactured burners are expensive and there is no reason why most of them should not be shop made, but they give poor economy unless properly designed. The burners are of the blue flame or Bunsen type, and require a definite amount of air, called primary air, for mixing with the gas as it enters the burner. The additional air required for combustion is called secondary air and is the air around the flame. This last term is rather loosely used and may be the atmospheric air around the flame or atmospheric air that flows by induction through ports near the end of the burner. There should be an excess of secondary air.

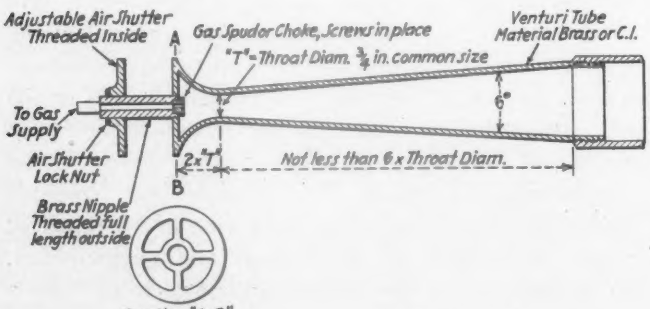


Fig. 1—Atmospheric-pressure gas burner

Atmospheric burners, that is, burners which operate without a compressed-air blast, furnish sufficient heat for melting soft metal, rivet heating and the like. These burners operate on a combination of the Bunsen-burner principle and the injector principle. A tiny jet of gas is used to induce a flow of primary air through a venturi tube, shown in Fig. 1. Gas at line pressure (1 to 10 lb. per sq. in.) discharges from the spud containing a small orifice into the small end of a tapered draw tube or venturi tube. The primary air is entrained by this flow of gas. In the small end of the Venturi tube a vacuum of several inches of water is formed. At the large or burner end of the tube the velocity of the mixture has fallen, but a slight pressure still remains. The principle of this device and the principle of Venturi tubes in general is based on Bernoulli's theorem (the injector principle) governing the flow of fluids through a tube of tapered section. The only function of the tapered injection tube is to utilize the energy of the gas in building up a slight pressure and to provide for air entrainment. The taper of this Venturi tube has an important bearing on the amount of air entrained. A given throat size in a straight pipe will deliver only about one half as much air as a tapered tube.

The ratio of the volume of primary air entrained to the volume of natural gas passed through the orifice is called the entrainment ratio; this varies from 9 : 1 to 12 : 1. Artificial gas requires about half as much air as this. The approximate ratio of burner area to orifice area should be 220 : 1 to 300 : 1. The lower ratios are for gas of low heat value (800 B.t.u.) and the higher ratios are for gas of high value (1,100 B.t.u.). The air shutter is a convenient way of regulating the air-gas ratio from zero to the maximum for which the burner is designed. Only about half the air required for combustion is entrained as primary air. Fig. 1 shows the proportions of an atmospheric injector. The area of the throat is one of the most important dimensions.

Atmospheric Injector Formulas

If v is the velocity of gas flowing through the orifice, m is the mass of gas flowing through the orifice in a unit of time, V is the velocity of the mixture flowing through the cross section of area A, and M is the mass of mixture flowing through the burner in a unit of time, then $MV/mv = C =$ a constant. For all burners geometrically similar but of different size C should have the same value.

The Orifice—The formula for the flow of gas through an orifice under small pressure is:

$$q = aK\sqrt{(h/d)}$$

where q is the quantity of gas passed in a unit of time, a is the area of the orifice, K is an orifice constant of coefficient of discharge that depends on the form of the orifice and the units employed, h is the fall of pressure through the orifice (ordinarily the pressure of the gas above the atmospheric pressure), and d is the specific gravity of the gas referred to air (air equals 1). If the rate of flow be expressed in cubic feet per hour, the area of the orifice a in square inches, and the fall of pressure h in inches of water, then the value of K for a sharp-edged orifice is about 1,000. If the orifice has a conical shape toward the gas supply, the value of K increases to about 1,090 for a 60-deg. cone.

Other (Arbitrary) Formulas.—Let a be the area of the orifice, d the density of the fuel gas, q the volume of gas flowing through the orifice in a unit time, m the mass of gas flowing through the orifice in a unit time, v the velocity of gas flowing through the orifice, A the area of any definite cross section of passage through the burner, D the density of the mixture of gas and primary air, Q the volume of mixture flowing through the burner in a unit time, M the mass of mixture flowing through the burner in unit time, V the velocity of mixture past a cross section of area A, and P, the total port area. The constant ratio of momenta is represented by

$$MV/mv = C = \text{a constant. Also}$$

$$Q/q = \sqrt{(AC)} \times \sqrt{d/aD)}$$

The arbitrarily chosen cross section A is a constant for a given burner; hence, $\sqrt{(AC)}$ is also a constant and may be represented by K.

Then:

$$Q/q = K\sqrt{(d/aD)}$$

and

$$K = (Q/q)\sqrt{(a\,D/d)}$$

For the purpose of predicting a value of K it is most convenient to take section A through the ports (or outlet of the burner) so that $A = P$, where P is the total port area. Experience has shown that the value of K may be assumed to be $0.8\sqrt{P}$, where P is the total port area in square inches, and the volume delivered is expressed in cubic feet per hour.

The Area of Orifice.—The orifice area can be expressed as

$$a = K^2(d/D)(q/Q)^2$$

In making up burners for shop use, mechanics usually prefer to follow closely the design of some successful burner rather than to calculate a burner from the formulas. Given the required heat value and the characteristics of the gas and the furnace, it is possible for the engineers to calculate the most efficient burner, and it will work successfully without experiment. A drawing of one of the handiest sizes for rivet heating and soft-metal heating is shown in Fig. 1.

Application of Burners to Existing Forges and Furnaces

Atmospheric Burners.—Atmospheric burners can be used in rivet furnaces, and where so used they should be arranged to fire down on the rivets at an angle of 45 deg., as shown in Fig. 2. This prevents chimney action which is to be avoided in a rivet forge for it draws air into the furnace and causes the rivets to scale. The products of combustion are vented through the door opening. An atmospheric burner with $\frac{1}{16}$-in. orifice and 2 in. in diameter at the large end of the Venturi tube will melt 500 lb. of lead in 15 or 20 min. in a crude brick-lined furnace. For lead melting, the burner may fire horizontally near the bottom of the furnace and the flame may impinge on the pot. A better arrangement is to use two burners firing tangentially near the top of the pot and to vent the products of combustion near the bottom, as shown in Fig. 3. This gives a quicker melt. The value of heat insulation is often underestimated by

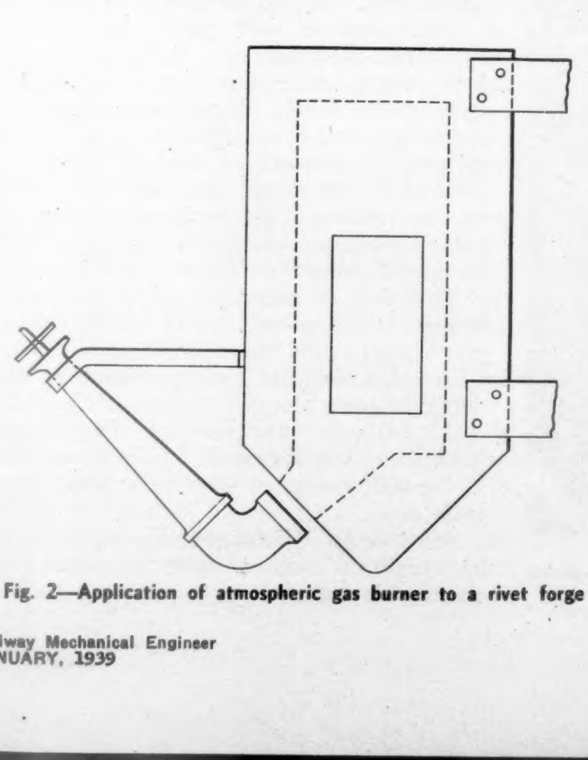


Fig. 2—Application of atmospheric gas burner to a rivet forge

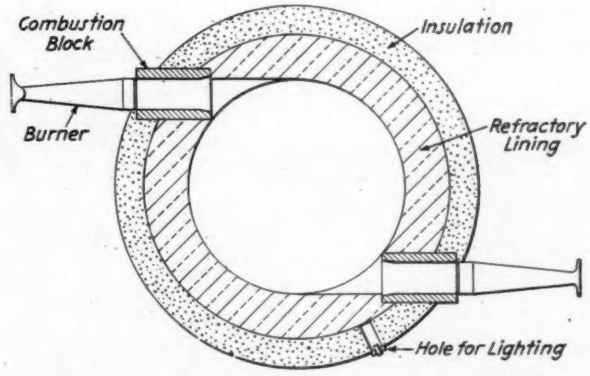


Fig. 3—Pot furnace arranged for tangential firing

practical men, for example, 4½ in. of good insulation like diatomacious earth will save 10 per cent of the fuel in an oven furnace operating at a temperature of 1,500 deg. F. or higher.

Blast Burners.—The blast burner differs from those just described in that a jet of compressed air is used to entrain the gas. The air jet also mingles with the gas as primary air. This type of burner operates on the same principle as a gas blow torch and is hotter than the atmospheric burner; it is used to fire boilers and to melt brass. A gas burner for starting fires in a coal-burning locomotive is shown in Fig. 4. As shown in

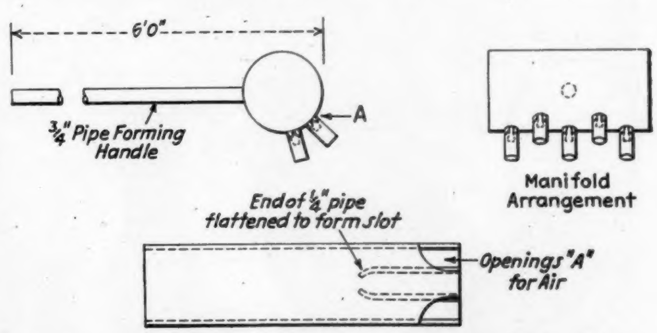


Fig. 4—Gas burner for starting fires in a coal-burning locomotive

Fig. 5, the air and gas are brought together in a mixing tee, which should be within a few feet of the flame end of the burner. A tapered tube is not always used in connection with blast burners, but their operation could be improved thereby for a jet of air leaves an orifice in the form of a cone with an angle of 15 deg. In shop practice it is customary to use full air-line pressure for blast burners, but where no compressed air is available the makers of gas appliances furnish a blower that supplies air at about 2 lb. per sq. in. that gives good results with small burners. When full shop-line pressure is used on a burner it may be necessary to throttle it to prevent blowing out the fire. It may be desirable to place a choke in the air line near the mixing tee so that the air valve will not require careful regulation. The makers of gas appliances furnish a proportional mixer with their blast burners, and part of the primary air is drawn from the atmosphere and mixed with the gas before it is boosted by the inspirator. These burners use only enough compressed air to build up the required pressure. When the gas is induced by compressed air, the pressure on the gas makes little difference and may be from 0 to 10 in. of water without materially affecting the operation of the burner.

The pressure developed in a blast burner is not as high as might be supposed; about 2 lb. per sq. in. is

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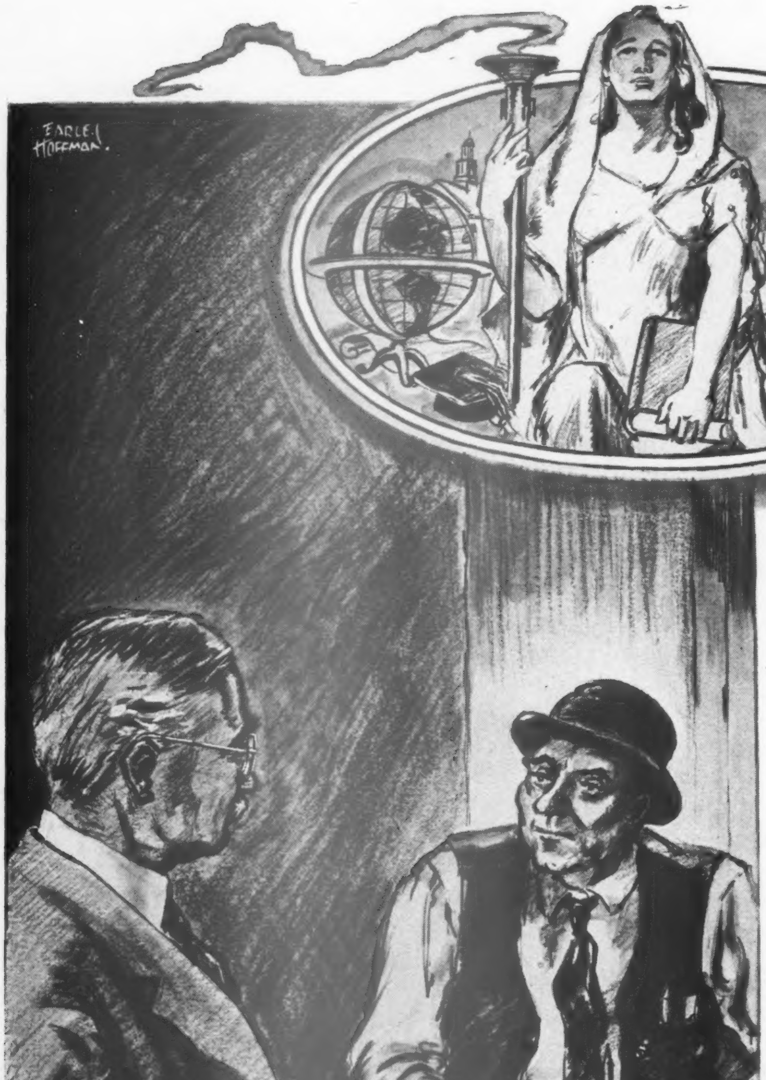


Evans was figuring what to do next when a short, round-faced man, wearing spectacles with heavy lenses came in

The Lucky Stiff

by
Walt Wyre

THERE was a time when proper training of apprentices was considered very important by railroad officers and apprentices alike. An apprentice really made an effort to learn his trade and railroads gave him an opportunity to do so. Time spent teaching a trade was considered an investment for the future that would pay dividends in more and better work when the apprentice became a mechanic.

There is a different attitude now, particularly among apprentices. In too many cases an apprenticeship is only taken because it means postponing relief or a W.P.A. job at least four years. That being the case, application is only wasted effort and study is useless worry, many apprentices figure.

Railroads for their part being too much concerned by problems of the present have little time for worrying over what might come later. As a result, railroad officers have been prone to accept apprentices as a necessary nuisance. Foremen worrying over reduced allowances can hardly be blamed for getting all they can out of apprentices and they reconcile themselves with the thought that he will be cut off anyway when he finishes his time.

That line of reasoning might be logical if Ponce de Leon had found the fountain of youth, but, as the voice in the news reel says, "Time Marches On." The retirement act is doing its part, too.

Altogether, indications are beginning to point to a shortage of well trained mechanics in the near future, if such a condition doesn't exist now.

Someone in Washington has evidently had his eyes open and seen how things are going, else legislation aimed at correcting the con-

dition would not have been effected. The result is that many states have accepted Federal aid for industrial education. Trade schools, training shops, evening classes and occupational courses have been established in many towns and cities, Plainville being among them.

Jim Evans, roundhouse foreman for the S. P. & W., was in the office worrying over the work report of the 5082. Engineer Haynes had reported it riding very hard again and Haynes is not one to report something just to keep from wasting the space on the form. There had been half a dozen or more similar reports and as many times work had been done on the engine aimed at correcting the condition.

Spring hangers had been gone over, shoes and wedges had been worked on, weight on drivers had been shifted, and about everything else affecting the riding qualities of a locomotive had been given attention at some time or other.

Evans was figuring what to do next when a short, round-faced man wearing spectacles with heavy lenses came in. "My name is Tate," the stranger said. "I'm supervisor of industrial education. Are you the foreman?"

Evans admitted he was and in a not too cordial tone asked what he could do for him.

The professor explained that there was a possibility of evening classes being organized that might interest some of the men employed in the railroad shops.

"What kind of classes?" Evans asked. "What do they teach?"

"Anything the men might want that would make them more proficient in their work—blueprint reading, mathematics."

"I wish somebody could figure out what's the matter with this engine!" Evans cut in with no intention of being rude.

Tate, somewhat disconcerted by the interruption, stood awkwardly silent for a moment. Then he tried again. "I though perhaps if you would call the men together at noon hour or sometime when it wouldn't interfere with the work I could explain about the school and—"

"O.K.," Evans said. "I'll have a bulletin put up. What day would you like?"

The meeting was called for 12:30 the next day in the machine shop. Evans, absorbed by matters of more immediate importance, told the clerk to put up a bulletin and forgot about it.

Next day the professor was in the machine shop at 12:25 practically alone. Two or three men that brought lunches were sitting on a bench in the warm corner of the shop. They paid no attention to the professor.

Tate stood around in the shop looking as much out of place as a man at a meeting of the Ladies Aid and feeling more so. He was just about ready to give it up as a bad job when the men began to come in almost in a bunch, but the foreman wasn't among them.

The men seated themselves around on work benches, driving boxes and anything else convenient. Most of them, somewhat peeved at having part of their noon hour disturbed wore a disgruntled let's-get-it-over-with air.

Tate nervously polished his glasses and waited for the foreman while the men fidgeted impatiently.

Finally deciding that it was up to him, the professor opened the meeting. He explained what was being done and told them about the proposed classes. "Now are there any questions?" he asked.

"If it would give me enough seniority to hold a job when I finish my time, I'd take it," Sam Ragan, a machinist apprentice, said to no one in particular.

"It won't do that," Tate replied. "But it might help you to hold a job if you get one." The professor was little provoked at the lack of interest.

Seven men put down their names as prospective students. Of the group, Jack Caldwell was a machinist apprentice. Ragan and Roy Miller, the other two apprentices, didn't figure it was worth the effort.

Other men agreed it was a good thing, but for various reasons they wouldn't attend.

Evans, still concerned over the 5082 and a thousand and one daily problems, didn't even know any further attempt was being made to organize a class. Tate felt that the foreman was to say the least not interested and didn't approach Evans again.

If Jack Caldwell had not been interested as he was, the class would not have been organized. After trying unsuccessfully to get more men in the roundhouse interested, he got enough to sign from contract shops in town, and the class was started with the minimum number of twelve. Practical shop mathematics was the subject they elected to take, two nights a week for twelve weeks.

All of the seven that attended the class from the roundhouse were interested, but young Caldwell was most interested. Each noon hour he could be seen off in a corner alone working out problems from the book or applying rules he had learned to problems he found in the shop. The other two apprentices kidded Caldwell a lot at first, but he ignored them and they soon quit.

One day Caldwell got even for the kidding in a practical way. A piece of steel shafting four inches in diameter, thirty feet long was shipped in to have some machine work done on it. At noon hour the men congregated around the shaft guessing at its weight.

"It'll weigh over a ton," Sam Ragan said confidently.

"Yeah, and then some!" Roy Miller said. "The schoolboy should be able to tell us what it weighs," he added pointing to Caldwell.

"Well, I don't know." Caldwell was doing some figuring in his head.

"Bet you five dollars I can guess closer than you can," Ragan said, meaning it as a bluff.

"I'd rather not bet on it," Caldwell demurred.

"And I'll make it another five!" Miller chipped in, bluffing too.

"All right!" Caldwell snapped. "Put up your money!" He pulled out a ten-dollar bill and handed it to Cox, a machinist, standing nearby. "We'll each write our guess on a slip of paper and hand it to Cox. Then he can get the weight from the storekeeper. The one nearest gets the money."

Miller and Ragan would have backed out of the bet, but the others started kidding them.

"All right, here's mine!" Young Caldwell wrote some figures on a piece of paper.

Ragan wanted to stall a while trying to figure the weight, but Machinist Cox wouldn't let him. "You started this; now back up your bluff " Cox said.

Ragan and Miller exchanged glances. Then Miller said, "Let me have your pencil."

"No framing up," Cox warned them.

"Oh let them go ahead," Caldwell said.

Cox opened the three guesses. Ragan estimated the piece to weigh 1950 pounds; Miller, 2275; Caldwell had down 1270 pounds.

The crowd rushed to the storeroom. "It is billed at 1280 pounds," the storekeeper said. "That might be ten or fifteen pounds off."

Then Ragan got mad. "You saw the bill!" he accused Caldwell.

"No, I never saw the bill, but I wasn't guessing—

much. I've learned a short method of figuring the weight of iron that is pretty close."

Cox handed over the two fives and a ten. "Wish you would tell me how you figured that weight; it might come in handy some time."

"Well, it's mighty simple. Thirty-six cubic inches of wrought iron weighs almost exactly ten pounds. So all you do is get the area of the end section in square inches, then multiply that by ten pounds for every yard, or three and one-third pounds per foot.

"In this case it would be 4 x 4 x .7854 for the area of the end. Multiply that by ten times ten figures about 1257. Steel is a little heavier than wrought iron, so I added a few pounds to it."

"Believe I'll start going to school," Cox commented.

In the meantime, Evans, like most other roundhouse foremen, was having troubles of his own. He finally corrected the rough riding of the 5082. He corrected it not by doing one thing, but several. The engine had just about shook herself to pieces; driving boxes were in bad shape, pins out of round, and the journals needed truing. He ran the engine over the drop-pit and went over it from pilot beam to draw.

Other things came up to occupy his mind, though, and he paid no attention to the class that was going on. He had, in fact, dismissed it entirely from his mind until one day he had a request from the superintendent to build an oil tank for a weed burner. The tank was to be round, hold 100 gallons, and be 5 ft. long. Evans turned the job over to Henry Barton, a boilermaker.

Barton scratched his head trying to remember the rule for figuring it and couldn't. The other boilermakers couldn't either. Barton went to the foreman. After using up half a pad of clip, Evans told the boilermaker to take it to somebody else.

After trying several mechanics, Barton gave the problem to Caldwell. The apprentice figured it in a very few minutes.

"Did you get the tank figured?" Evans asked Barton later on.

"Yeah, had to get an apprentice to figure it. Seems like a lot of us could get something out of that school!"

After the holiday season was over, business fell off as usual and the S. P. & W. appropriations were reduced. Evans had no alternative but to cut forces. It was a bad time for apprentices to come out of their time, but it worked out that way. Ragan and Miller finished the first part of January and managed to get a few days extra work in place of men laying off. Caldwell finished in March and there wasn't any one laying off.

About that time the railroad decided to build some much needed treating plants, the largest at Plainville. Sanford was to be the next largest with several smaller automatic plants along the line. The same contractor obtained contracts for both the one at Plainville and the one at Sanford.

Work started on the one at Plainville the first of April. Before work started, the foreman in charge came to Plainville to make preparations. "I'm going to need half a dozen or so laborers when the work gets started and I could use two or three what I call handy men. Not necessarily mechanics, but fellows that know something about using tools."

Evans told the foreman, Darnall by name, about the three apprentices that had been cut off. "If you need any figuring, Caldwell is pretty good, they say," Evans added.

Evans sent word to the three men that they might get jobs with the contractor and to go see him.

All three immediately rushed down to call on Darnall.

"Well, to tell you men the truth, I haven't had much luck with railroad mechanics," Darnall said. "Railroad work is different from most other jobs. I won't need you men until Monday," he added. "Report then and I believe I can give you jobs. The pay may not be quite as good as you've been getting, but," Darnall smiled, "I'll try to pay you what you are worth on the job."

The three men started to leave when the foreman stopped them. "I might be able to use one of you the rest of the week. I've got a lot of figuring to do, material to order, and so on." Darnall scratched his head. "All three of you look like pretty intelligent men. If you don't mind, I'll just give you each a little problem I was figuring when you came up. Here, sit down."

The foreman made room for the three to sit at an improvised desk and handed them paper and pencils. "Part of the job is a round sump tank twelve feet deep, sixty feet in diameter. It will be set in the ground four feet deep. It will be built of cement sixteen inches thick. How many yards of dirt will have to be moved and how many yards of concrete will be required for the job? I might add how many feet of lumber will be needed for building the form, but guess that would be too much."

Caldwell started figuring. Ragan and Miller fidgeted nervously and chewed the ends of their pencils.

"I don't believe I could figure it right off-handed," Ragan said.

"Me neither," Miller said. "It's been quite a while since I went to school." He cast a sneering glare towards Caldwell, who already had figured the cubic yards of dirt to be moved.

"Well, boys, come back Monday," Darnall told them. Then to Caldwell, "Looks like you win the job by default. I believe you are the man Evans told me about."

"Thanks," Caldwell said without looking up from his figuring.

"Lucky stiff," Ragan said as the two walked away.

"Damned hand shaker," Miller chimed in.

Darnall said something about going to town a few minutes and left young Caldwell alone with his figuring.

Caldwell finished figuring the job and checked his figures carefully to see that he had made no mistake. The foreman had not returned, so Caldwell figured the amount of lumber required for the form. He didn't know how the form was to be braced, he could only guess at that.

That finished and with nothing else to do, he started looking over blue-prints of the job. The foreman stayed away over an hour and Caldwell had time to look the prints over pretty well. He was studying the piping when he came to a place where two six-inch pipes joined a ten-inch pipe. He was not familiar enough with the work to know just what was to be done, but it didn't look right. While he was pondering over it, Darnall returned.

"Well, did you figure it out?" the foreman asked.

"Yes, sir, and for lack of something better I was looking over the prints."

"Did you find anything wrong with them?" Darnall asked jokingly.

"Well, I don't know," Caldwell said hesitatingly.

"What do you mean don't know?"

"Right here," Caldwell pointed at the print, "where two six-inch pipes join a ten. I didn't know whether the combined volumes should equal the one or not."

Darnall looked at the print. "Well, I'll be damned! Somebody else might have caught it and they might not. It could have caused a lot of trouble." The foreman picked up a pen, dipped it in white ink and started to write. "What size should they be?" he asked.

"If one of them was an eight-inch pipe and the other a six, they would carry as much together as the one ten-inch."

"This one should be an eight. It's supposed to carry almost twice as much as the other." Darnall made the corrections on the print.

Miller and Ragan went to work Monday morning. They were assigned jobs that might be classed as helpers' work with a corresponding rate of pay. It galled them terribly to see Caldwell on an easier job and with a better rate of pay. What hurt them most of all was to see the younger mechanic carrying a roll of blue-prints and checking work done by them.

The job lasted four months. Ragan and Miller stayed at the same job they started with until it was finished. Each had threatened privately to quit several times, but the pay was better than WPA jobs offered, so they stuck.

After the job was completed, Darnall told Caldwell to stick around a few days and see that everything operated O. K. "There's always a few bugs in a new plant," he added.

"How long do you want me to watch it?" Caldwell asked.

"Oh, two or three days."

"What will I do then?"

"Why, come to Sanford soon as you can. We're starting work there," Darnall grinned, "and being as it's away from home I might be talked into giving you a little more money."

"Thanks a lot, Mr. Darnall."

"Oh, hell, don't thank me; thank yourself for trying to learn something."

The foreman went to the roundhouse office to tell Evans goodbye. "And," he added, "I'm taking young Caldwell along with me. If the railroad doesn't need men like him, we do!"

"Lucky stiff!" Miller snorted when he heard about it.

Gas Burners for The Railroad Shop

(*Continued from page 23*)

probably the maximum. The flame end of the burner should have a number of small holes 1/32 in. to 3/32 in. in diameter. If an attempt were made to burn the mixture at the end of the unobstructed pipe, it would blow out. In a furnace, however, the gas will burn against the brick wall several inches from the end of an unobstructed pipe—a sort of surface combustion.

If an attempt were made to burn natural gas without mixing it with primary air it would burn with a long lazy flame tinged with yellow. When the air blast is turned on it sharpens up and turns blue, and the tem-

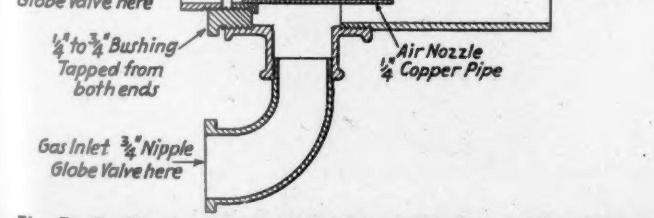


Fig. 5—Combination mixing tee and inspirator for gas blast burner

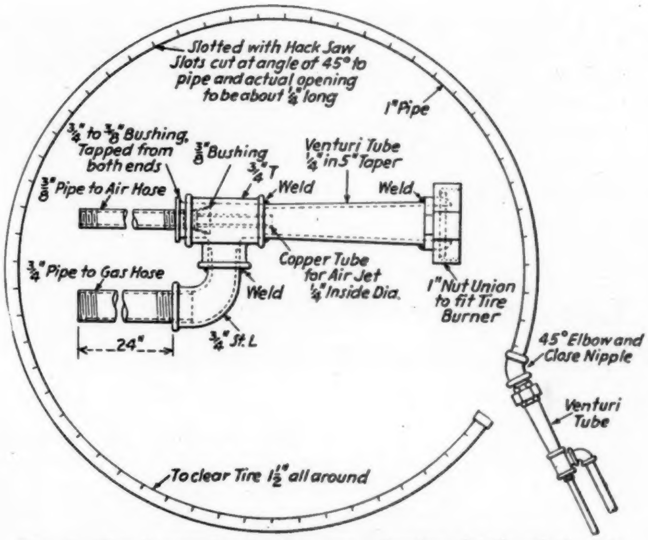


Fig. 6—Tire heater for burning gas, showing details of the air injector and the gas mixing tee

perature of the flame is increased. The air blast causes the flame to burn with a sharp roar that would be objectionable for some domestic use. Regarding the burner it may be said that the smaller and more numerous the ports the better will be the characteristics of the burner. On account of the difficulty and expense of drilling many small holes the possibilities of improvement along this line are limited.

If the holes are made small enough, conditions approximating "surface combustion" will be obtained. This is the combustion of an air-gas mixture within a porous medium without flame. The porous material becomes incandescent and an intense heat is produced with a small consumption of gas. Such a plan has been tried for heating lead pots. The furnace is packed with porous refractory material filling all the space between the sides of the furnace and the pot. The air-gas mixture is introduced through a number of small pipes near the bottom to give an even distribution and prevent backfiring.

Tire Heaters

Tire heaters have been developed which operate very efficiently using gasoline, distillate, or kerosene as a fuel. The same burners do not work very well using gas as a fuel; however, by drilling more holes in the burners about 1/16 in. in diameter and 2 in. apart, fair results with the burners will be obtained. Gas burners work better if made out of larger pipe than is commonly used for burning vaporized liquid fuel; 1/2-in. pipe is used commonly, but 1-in. or 1 1/4-in. pipe is better for gas burners. It might be supposed that if the mixture supplying the burner flows through a 1/2-in. pipe nothing would be gained by using a tire hoop made from pipe of larger diameter. Experience and the laws of physics governing the flow of fluids through tubes of varying section show that a considerable pressure is built up in the larger pipe, which therefore makes a better tire heater. It is desirable to place these tire heaters on the wheels of locomotives in the enginehouse without removing the brake shoe or raising the wheels more than 1 in. above the rail; thus, a 3/4-in. pipe is about as large as can be used here. For backshop use, where the wheels are removed from the engine, larger sizes of pipe may be used for burners. Some efficient tire heaters have been made from 1 1/4 in. pipe perforated every 3-in. by sawing slots crossways with a hack saw, as shown in Fig. 6. The openings in the pipe should be about 1/4

in. long. An air blast is always used for tire heating. Heaters using distillate or kerosene have a double coil with a return bend, the first being used to preheat the mixture. This double coil is not necessary when gas or gasoline is used as fuel. In changing over this type of burner for use with gas, they work well if both coils are drilled.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Computing Tube-Sheet Braces

Q.—Kindly furnish me with the necessary information for computing the front tube-sheet braces of a locomotive boiler.—F. H.

A.—The area of the back or front tube sheet to be stayed shall be the area enclosed by lines drawn 2 in. from the outside of the tubes or the center of a row of stays and at a distance D from the shell or wrapper sheet. The area of dry-pipe hole in the front tube sheet should be omitted from the area as obtained above since it is assumed that this area is supported by the dry-pipe fastenings and superheater header.

The value of D used may be the larger of the following values:

(1) $D =$ The outer radius of the flange, not exceeding eight times the thickness of the back head or front tube sheet.

(2)

$$D = \frac{5 \times T}{P}$$

where $D =$ unstayed distance from shell or wrapper sheet in inches, $T =$ thickness of back head or front tube sheet in sixteenths of an inch, and $P =$ maximum allowable working pressure in pounds per square inch.

When the back or front tube sheet is supported with both gusset and rod braces, the stress on the rod braces should be calculated separately from the gusset braces.

In calculating stresses on braces and their attachments, the angularity of the brace, if in excess of 15 deg., must be taken into consideration. The practice in calculating stresses on braces is to take the product of the entire area supported by either the rod or gusset braces and the boiler pressure and divide this product by the sum of the least cross-sectional area of all the rod or gusset braces.

This method should be followed, providing the braces are uniformly spaced. If one or more of the braces are so segregated as to receive more than their portion of the load, they must be calculated separately from the rest.

In taking into account the angularity of the braces, the angle of each brace must be found and its sectional area must be reduced in proportion to the angle that the stay makes with a line drawn at right angle to the surface supported, as explained in the following paragraphs. This is to be done in preference to increasing the load in proportion to the angularity of the brace so as to avoid the necessity of calculating the area supported by each individual brace.

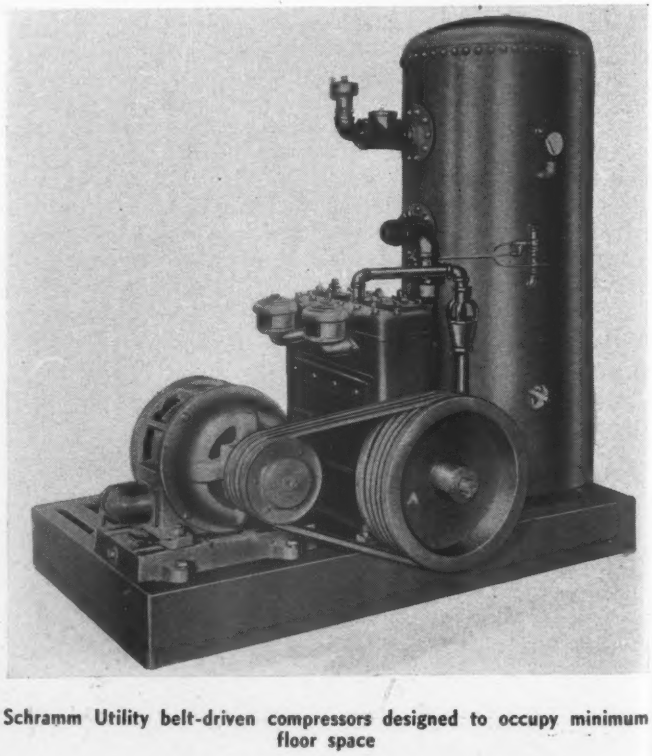
The angle of each brace must be ascertained and, if in excess of 15 deg. the area of the brace must be reduced by multiplying the area of brace by the cosine of the angle that the brace makes with a line drawn at right angles to the area supported.

The line representing the angle of the braces shall be the center line of a rod brace, and on gusset braces the center line shall be a line intersecting the front rivet in the flange where it is riveted to the wrapper sheet and the bottom bolt in the back-head angle irons where the gusset plate fastens to the angle irons.

Compact Stationary Air Compressors

The illustration shows an adaption of the Schramm Utility stationary compressors for belt drive as now offered by Schramm, Inc., West Chester, Pa., in 120-, 150-, 230-, 300-, 380-, 450- and 600-cu. ft. sizes. The features of the complete assembly include compact dimensions because of the modern, straightline compressor design, together with short vee-belt drive and vertical air receiver. These elements have been assembled into a complete plant, mounted on a single-frame base to occupy minimum floor space. Smooth performance of the compressor makes it unnecessary to provide any special foundation, the base supplied serving as the compressor's own foundation.

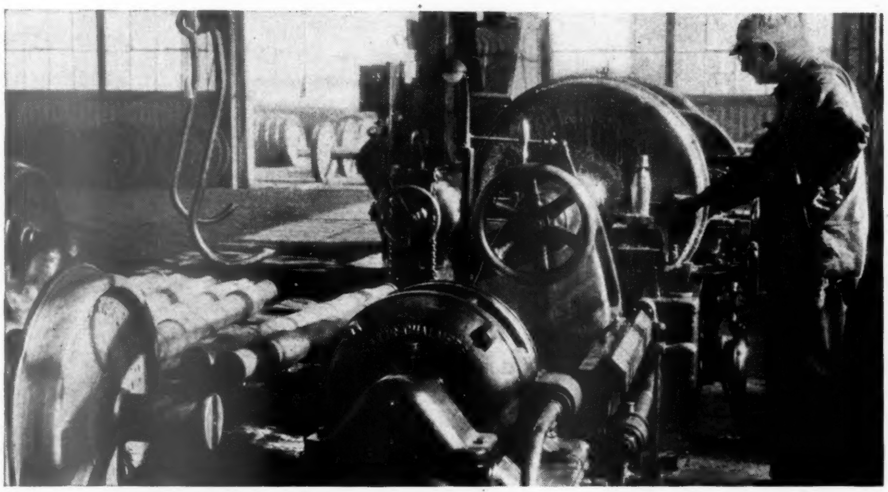
Another economy is introduced by the adoption of 1,800-r. p. m. motors for driving the compressors. The compressor unit itself includes such mechanical features as force-feed lubrication, mechanically operated intake valve, discharge valve occupying fullhead area, smaller and lighter moving parts, and thorough cooling by water.



Schramm Utility belt-driven compressors designed to occupy minimum floor space

With the Car Foremen and Inspectors

Wheel Shop Observations*



By H. F. Ripken

THE enormous cost of applying or replacing approximately a million pairs of car wheels per year in the United States and Canada, along with the even greater cost resulting if not replaced at the proper time, makes wheels and axles probably the greatest problem of railway maintenance.

One thing observed lately is that, since the removal of the rule that permitted through-chill wheels to remain in service until down $\frac{1}{16}$ in. in 12, fewer broken wheels are received at the wheel shop. It is not unusual for the shop inspection to find wheels broken or starting to break up where the through-chill spot is just starting down, and considerably less than $\frac{1}{16}$ in. within a radius of 12 in.

Observations and shop inspection of broken and cracked chilled-iron wheels indicate that the through-chill wheel that has started to give or go down is probably the most dangerous wheel in service. With the present higher and constantly increasing speed of freight service, a heavily-loaded car plus a wheel with a through-chill spot is a mighty poor combination and one that should be eliminated by the removal of the wheel from service as soon as possible after there are indications of the spot becoming low.

Uniform Wheel Hardness Sometimes Lacking

Another observation is that, while many advances have been made in wheel design and structure, there is still an apparent lack of uniform hardness or wearing quality in the tread of too large a percentage of wheels and tires; this, regardless of type or whether they are cast-iron, cast-steel, rolled-steel, and one- or multiple-wear wheels or steel tires. This apparent lack of uniform hardness is shown by the uneven tread wear found on wheels removed for other causes and long before they take the tread-wear gage. This is revealed as such wheels pass through the wheel and journal lathes in the shop.

An illustration of this in cast-iron wheels was brought out recently at our shop. Seventy-five pairs of 60,000-lb. capacity cast-iron car wheels were selected after a hand inspection of two hundred pairs of O. K. second-hand wheels removed from dismantled cars. These wheels were run through the mounted-wheel journal lathe in order to obtain wheels with true running treads for caboose service. Of the seventy-five pairs, only four pairs, or a little over five per cent, were found to run within $\frac{1}{32}$ in. of true, and this from uneven wear and not improper boring. None of the 200 pairs from which these wheels were culled out had over $\frac{1}{8}$ in. tread wear.

It is known from experience that a low spot of $\frac{1}{32}$ in. in 12 in. on a 33-in. or 36-in. wheel will pound to such an extent as to cause hot boxes on engine-truck wheels under locomotives in high-speed service. This illustrates the blows that wheels developing uneven tread wear must administer to road bed and truck and, to an even greater extent, to the superstructure of locomotives or cars and the merchandise with which the car is loaded. The resulting maintenance and damage to loading will grow enormously as train speed increases, as it is now doing, unless this condition is improved.

Low Spots Developed by Rolling Action

As engine trucks are not equipped with air brakes, the low spots are developed from rolling action only, confirming opinions that such low spots, or unequal tread

* Excerpts from a paper presented at the December 5 meeting of the Northwest Carmen's Association by H. F. Ripken, wheel shop foreman, Soo Line, Minneapolis, Minn.

wear, are not necessarily the result of braking action, but have probably been brought about by lack of either uniform hardness or wearing qualities in the tread of the wheels and tires.

Low spots, in one or more places, of 1/32 in. to 1/4 in. in depth with comparatively little tread wear, are not unusual. These, while more pronounced in heavy tender service of 70,000 lb. and especially 100,000 lb. capacity tenders, also appear on the lighter 60,000 lb. and 80,000-lb. car and coach wheels; seemingly, indicating that this trouble is caused by lack of uniform tread structure in the wheels and tires.

Unequal hardness or wearing qualities in mated wheels, we believe, contributes also to considerable cutting of flanges. Better or more careful handling and heat treatment of all types of wheels should improve conditions and surely result in savings to the railways.

The removal from service of wheels developing low spots or uneven tread wear, as soon as noticed, not only saves road bed, track, cars, and lading, but also saves the wheel tread and service metal on steel wheels and tires. The resulting pounding rapidly destroys the tread structure, and may cause wheels to break, or make it necessary to scrap expensive steel wheels, if not removed in time.

In connection with steel wheels developing low spots from manufacturing defects, there are also the wheels developing defective tread spots from slid spots which are permitted to run. While we know of no accurate data as to how many miles a wheel with defective tread structure will run before the defects become apparent, such information as we do have on tender wheels indicates that these wheels usually have to be removed in from 1,000 to 2,000 miles after spots start to develop. The present A. A. R. charge per 1/16 in. of service metal is from $1.11 to $1.27 for 33-in. wheels, and $1.82 per 1/16 in. for 36-in. passenger-car wheels.

Compensation for Defective Steel Wheels

Compensation for defective steel wheels may not be claimed from the manufacturer unless the defect exceeds 3/8 in. in depth, which is more than most defects by 1/8 in. As it does not pay to remate wheels unless service-metal loss exceeds 1/4 in. the average defective wheel, along with its mate, is turned up without remating, with a probable average loss of 1/4 in. on each wheel, at a cost per pair of from $8 to $15 in service metal alone.

As the wheels must be removed from service anyway in such a comparatively short period of time or service, it would appear to be the cheapest and most economical thing to remove wheels as soon as defective spots appear, and not wait until, in addition to the removal cost, the railroad must also pay for the unnecessary service-metal loss and possible wheel scrapping, as well as the incidental losses defective wheels have on tracks, equipment, and lading.

Along this line, some criticism of the out-of-round rule on new cast-iron wheels may be justified. This rule, Page 81, Par. B, in the Wheel and Axle Manual reads, "Each wheel shall be so nearly circular that a true metallic ring placed on its tread and bearing somewhere on the cone, shall, at no point, be more than 1/32 in. from the tread."

You will note there are no restrictions in this rule as to how many low spots up to 1/32 in. are permissible, or as to the length or shape of such low spots. A check of new mounted wheels reveals a condition not the best for high-speed service, as shown in the journal lathe and by complaints received on new cast-iron wheels placed in caboose service.

Economy of Chilled Wheels Increased by Grinding

There does not seem to be much question as to the economy of using chilled cast-iron wheels, but it would probably be much greater if all new cast-iron wheels were ground before being placed in service. The results obtained from such grinding would be well worth the additional cost to the railway company for having all new wheels ground at the foundry.

Again referring to the Wheel and Axle Manual: In Par. 81, Page 104, is the following on inspection of new cast-iron wheels: "Where the tread shows a rough and wrinkled surface from fire-cracked chillers, the manufacturers should be notified to rectify condition, as this, when pronounced, is cause for rejection." Why not clear this rule by defining how far across the tread and

* * *

50-ton Hart selective convertible hopper car for ballast service built by the American Car and Foundry Company for the Chicago, Burlington & Quincy

how deep the wrinkles from fire-cracked chillers are to be accepted as O. K. by the railway company? There are too many arguments over this rule.

Also, Par. 88, Page 105, pertaining to seams in new wheels, which states the seriousness of this defect and need of rejecting new wheels which show any such indication, and then illustrates an extreme case of seamy tread developed in service, as shown in Fig. 68. Why not show an illustration of what should be rejected in a new wheel, and save a lot of arguments as well as broken wheels in service?

The same applies to Par. 94, which states "If the plate shows accumulation of dirt in the metal the wheel should be rejected." What is an excessive accumulation? There is nearly always some dirt.

Regarding Par. 95, which reads, "Wheels with the tread wrinkled or rough or with the sand rim projecting above the chilled surface of the tread, may be ground to make them acceptable, unless the defects are too pronounced or indicate weakness resulting from cold pouring." Why not clear the rule up with illustrations as to what wheels should and may be ground, and as to what is too pronounced or indicates weakness?

The same applied to shifted flange, Rule No. 96. These are occasionally received at the wheel shop after being in service with flanges shifted up to 1/4 in., indicating that more attention could be paid to this rule at both foundry and wheel shops.

Carbide-Tip Tools In a Car Shop

*By C. G. Williams**

While I was testing carbide-tip tools in a railroad shop, the machinist who had the job of reconditioning car-axle journals came into the shop to grind four tools which had been dulled in trying to start a cut on a hardened journal that had run hot and been cooled by the application of water by the train crew. This machinist came to the lathe where the test was being carried on and after watching the job for a few minutes, went out with his tools, only to return in about 15 min. with the same four tools to be ground again. In one case, 1/8 in. was ground off a tool before it was sharp, and in each case it was necessary to walk about 600 ft. to the grinding wheel.

As this mechanic came past the lathe the second time, he asked, "Is that material hard enough to cut a burned axle?" He was told that it was hard enough if the machine would pull the load, and then he asked permission to take a carbide-tip tool and try it on burned axles.

By the time that the carbide-tip tool had been prepared and taken to the car machine shop, three more high-speed-steel tools had been dulled ready for grinding. The carbide-tip tool was put on the lathe and the cut started. This lathe, salvaged from the scrap pile, was probably 65 years old. The head had been knocked down, leaving but the main spindle and bearings. A 10-hp. d.c. motor, 1,140 r.p.m., had been installed on top of the head and so connected by link belt to the main spindle that a single speed of 140 r.p.m. was obtained. The apron had likewise been dismantled so that the feed was in but one direction and but one rate of feed could be used.

* Consulting engineer

The head spindle was equipped with a special chuck, while the tail-stock spindle was equipped with a ball-bearing center. The carriage was equipped with a special tool holder that gave great rigidity to the carbide-tip tool. (The writer has found by making thousands of tests, that most old machine tools may be equipped with carbide-tip tools and operated to advantage, providing that the tool rest is of such a type as to give a rigid support to the tool, that the machine has sufficient power to give the speeds required and that the machine, if a lathe, is equipped with a ball- or roller-bearing tail stock center).

The spindle speed of 140 r.p.m. gave 219.9 surface ft. per min. with a 6-in. journal. The feed was .018 in. per revolution and the depth of cut varied from 1/64 to 3/16 in. As even the fillet at the hub was generally burned, and always roughened, it was necessary to rework this also, so that from 1/32 to 3/32 in. was removed in reconditioning the journal with high-speed-steel tools.

If the journals are not burned they can be turned at the above speeds, feed and depth of cut with standard grades of high-speed steel by grinding the four tools on an average of every two hours, which gives an average of three journals per grind per tool. In this way 24 sets of wheels can be reconditioned in a day of eight hours, but if the journals have been burned or even discolored by heat in any part, the production is reduced to as low as eight sets of wheels per eight hours, with a grinding of four tools every 15 min. of use.

Although the carbide-tip tool was not of the correct shape to give production on the journals, the fillet could be rough turned by hand feeding of the tool to remove the hard outer shin; then the fillet could be finished with a high-speed-steel tool and the entire surface rolled to a glass-like finish with a special stellite roller.

While the machinist was skeptical as to the ability of the tool to cut the hardened steel, the writer had only in mind the rigidity of the set-up and the type of tool put on the lathe, so he was much pleased to find these items of the best obtainable. The tool was put on the lathe at 10 a.m. and one set of journals completed in the same average time as for soft journals. After one set of journals had been turned, sets of wheels were picked out that had one or both journals burned, and, in this way, five burned journals were turned on four sets of wheels with the carbide tools by the time the whistle blew for noon.

Though the tool was in good condition to continue the work indefinitely, the car foreman was so well satisfied with the test that it was called off and the original test that had been stopped was continued.

In the writer's opinion this was a very satisfactory test, the only unfavorable condition being that the one speed of the machine cut down the possible production with carbide tools on burned journals to the equal of that performed by high-speed-steel tools on soft journals. It would have been much better had it been possible to have increased the speed to 350 surface ft. per min. or more, as with the feed and depth of cut for which the tool was equipped, carbide tools would have given their greatest efficiency with a higher speed.

One thing that the machinist called our attention to was the fact that a saving in journal size, therefore journal life, was affected by the use of carbide tools as only a minimum of steel need to be removed to give the required finish while with high-speed-steel tools at least double the amount of metal must be removed to get under the skin of burned metal, and where the journal was out of round, the surface on the low side could be just scraped if carbide tools were used.

Gasoline-engine driven crane-type truck with capacity of 5,500 lb. handling three pairs of mounted wheels at the E. St. Louis shops of the Illinois Central

Expeditious Handling Of Car Materials

The illustrations included with this article show two pieces of equipment which save, in the aggregate, a large amount of time and labor in handling car materials at the East St. Louis, Ill., shops of the Illinois Central. Referring to the first view, an unusually powerful type of crane-equipped truck and trailer is shown handling three pairs of mounted car wheels which can be readily done on either smooth or rough roadway, providing the surface is fairly hard. The gasoline-engine-driven tractor, known as a Krane Kar, is very flexible and operates readily in either direction, turning in a short radius by steering-wheel control of the small rear wheels. The rugged boom has a capacity to lift 5,500 lb. at 5 ft. radius and a factor of importance is the possibility of raising or lowering this boom while it is being rotated in either direction.

The trailer is a shop-made device constructed of a heavy steel casting horizontally hinged to the front of the tractor by a substantial pivoted connection and equipped with two individually swiveling truck wheels which enable the trailer to be pushed, pulled, or swung in any direction at the will of the driver. This arrangement of boom-equipped tractor and trailer proves very convenient for the easy and rapid transportation of car wheels about the shop, loading and unloading of cars, as well as handling other heavy materials of all kinds.

The motor-cycle delivery car, shown in the second

This motor-cycle delivery car provides a rapid and flexible means of handling materials of various kinds around shops and terminals

illustration, also provides a fast and flexible means of delivering materials of all sorts about the Illinois Central shops and terminal. It consists, in this instance, of an Indian motor cycle equipped with a steel frame extension to the rear wheels which are chain driven from a differential and transmission designed to be run at somewhat reduced speed. The three-inch steel channel framework is hinge-connected to the motor-cycle frame at the front end in such a way that a slight adjustment permits taking up slack in the driving chain without much difficulty. The welded steel box mounted on the rear of the frame between the two wheels is 33 in. wide by 54 in. long by 15 in. high, dimensions which seem best adapted to average requirements.

This motor-cycle delivery car is operated about the shop on a more or less regular schedule to pick up orders and deliver material where needed without the necessity of shop men leaving their stations or being delayed waiting for material. The speed and flexibility of this unit makes it a valuable asset in any scheme of shop material delivery.

One Cause of U-12-B Valve Failure

On August 2nd, 1938, it was necessary to set out a coach on an eastern road due to the trailing pair of wheels on the rear truck having 5-in. slid-flat spots. This car was fitted with a U-12-B Universal valve, which has been inspected after the car was set out. The record showed that this valve released and applied automatically on its own accord without any supply of air being connected to the brake pipe.

From the information received it was not clear whether the brake pipe was drained at the time the car was set out or whether the angle cocks were closed and the brake-pipe pressure retained. The air-brake foreman reported that he had made a single-car test of the car and found it had 2½-lb. brake-pipe leakage and failed to pass the emergency test, but on operating a cutout cock several times, this leakage was eliminated.

With this 2½-lb. leakage it was felt that at the time of the air-brake foreman's inspection the U-12-B valve must have been in emergency, because it was 20 miles from the original point to that where the defect occurred. It was believed that the air-brake foreman could not have made his inspection in less than 25 min., and in that time the brake-pipe pressure would have dropped sufficiently to cause the protection valve to cut in and place the U-12-B valve in an emergency position.

In testing this valve on the U-12-B test rack, it passed all tests except the quick-action-chamber charging test which took 9 min. to charge to 70 lb. An examination of the valve disclosed that the ball-charging choke in the emergency-slide-valve graduating valve was stuck in its cavity.

So far as the record shows, only one pair of wheels were mentioned as being slid flat and there was no indication of the other wheels being heated due to brakes dragging. It is believed, therefore, that the cause of the slid-flat spots on the trailer pair of wheels was probably some irregularity in the brake rigging.

Regardless of what happened to the wheels, such action is attributed to insufficient charge of the quick-action chamber occasioned by a gummy deposit around the charging ball choke. With the reservoirs charged, as would be the case since these derive their charge from the service portion, air must have been trapped in the brake pipe when the car was cut out and a service application was developed due to the leakage from this line.

When the service portion moves to the service position to admit auxiliary and service-reservoir air to the brake cylinder, emergency-reservoir air from beneath the high-pressure valve will be admitted to the emergency slide valve seat port b-1*. As little pressure has been built up in the quick-action chamber, the emergency piston *will remain in its release position.* If there be an abnormal clearance between the top of the emergency-slide-valve wings and the broached guide grooves in the top of the slide bushing, the slide valve will be lifted from its seat a slight amount *to momentarily unseat the high-pressure valve.* This results in the safety-valve cutoff valve moving upward to connect passages W-1* and M* to release brake-cylinder air through the emergency-portion exhaust through passage O and cavity N*.

The emergency slide will reseat as some emergency reservoir air is passed to the quick-action chamber from the space beneath the high-pressure valve. By so doing, the high-pressure valve reseats; however, the safety-valve cutoff valve will remain in its upper position until the pressure in the space beneath the valve (brake-cylinder air) drops to a comparatively low value, at which time the release of brake cylinder air through the emergency exhaust will cease.

* See New York Air Brake Company's pamphlet No. 5050-4, Figs. 29 and 31.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. A. R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Responsibility for Repairs And Owner's Defects on Derailed Car

The Chicago, Milwaukee, St. Paul & Pacific badly damaged an Atlanta, Birmingham and Coast hopper car in an accident. The car was later reported to owners as destroyed, with a request that they furnish a depreciated-value statement; however, after the statement was submitted the C. M. St. P. & P. elected to repair and return the car to service, and prepared a billing repair card marked "no bill" with the exception of wheels applied at R. & L-2, for which the C. M. St. P. & P. charged the owner in accordance with Rule 75. They also charged for re-light-weighing and stenciling the car after receiving extensive repairs, because the car was due for re-weighing in accordance with Rule 30, Section C.

The owner contended that due to the fact the car was badly damaged, requiring renewal of approximately 75 per cent of the car body, as well as repairs to the trucks, the charge for re-weighing the car should be absorbed by the repairing line.

In rendering a decision on November 11, 1937, the Arbitration Committee stated: "The contention of the Chicago, Milwaukee, St. Paul & Pacific is sustained."—*Case No. 1,762, Atlanta, Birmingham and Coast versus Chicago, Milwaukee, St. Paul & Pacific.*

High Spots in

Railway Affairs . . .

Wages and Hours

Whatever one may think of the wage-hour law, favorable or otherwise, there seems to be a more or less general agreement that Administrator Elmer F. Andrews is giving an excellent account of himself in its administration. A civil engineer by training, he is also a railroader, having served with the New York Central, the Bangor & Aroostook and the Seaboard. Modest in disposition and a clear and unbiased thinker, he makes a decidedly favorable impression on those with whom he comes in contact. Business Week, in commenting on the recent meeting of the National Association of Manufacturers, said that next to Anthony Eden, Andrews was the biggest drawing card, who "packed them in to the rafters." "Also interesting to most listeners,' said Business Week, "was Senator Burke's remark . . . that what the Wagner Act needed was administrators like Andrews."

"Feather-Bed Rules" Challenged

Some peculiar decisions have been made by the National Railroad Adjustment Board, heavily penalizing the railroads in connection with the so-called "feather-bed rules." Interestingly enough, no method is provided under the Railway Labor Act by which a railroad may test out an Adjustment Board decision in court. On the other hand, ample machinery has been established to enable employees to take court action against any employer who fails to abide by the decisions of the board. The Washington (D. C.) Terminal Company has broken the ice and has filed suit in the United States District Court for the District of Columbia, challenging the demand of the Brotherhood of Locomotive Firemen and Enginemen and the Brotherhood of Railroad Trainmen that the Terminal Company be required to employ special, additional switch engine crews to back trains and empty cars between the passenger station and the storage yard. The road engine which brings the train to Washington has to go to the roundhouse, and since the yard where empty trains are stored is between the station and the roundhouse, it has always been the practice, when necessary to secure prompt and efficient operation, to have the road engine take the train to the storage yard on its way to the roundhouse.

Legislative Prospects

The President's Committee-of-Six has made its report, which is excellent, except that as might be expected of a committee made up of equal numbers of representatives of management and labor, it carefully refrains from recommendations which in any way would affect labor. The report of the Transportation Conference of the Chamber of Commerce of the United States has not yet been made public, but this body, consisting as it does of representatives of various business groups, may be expected to magnify its own selfish interests and place emphasis on those things which will least affect them. Other special interests will undoubtedly press their claims before the Senate and House Committees. The Interstate Commerce Commission, naturally, made a number of recommendations in its annual report to Congress. The House Committee has announced that it will begin holding hearings on an omnibus railroad bill after the middle of January. Whether the Senate Committee, which is dominated by Senator Wheeler, will take any constructive action, remains to be seen. Just now the Senator seems to be interested in the fantastic Hastings postalized rate proposal. It is hoped, however, that Congress and the Administration will have the determination to do something really worthwhile in constructive legislation, which will insure the railroads a square deal.

Fierce Competition

In his annual review of railway operations in 1938 in the Railway Age, Dr. Julius H. Parmelee, director of the Bureau of Railway Economics, directs attention to the growing intensity of competition in the transportation field. He points out that according to the American Trucking Associations, the number of truck loadings during the first 11 months of 1938 decreased about 13 per cent, as compared with the same period in 1937, whereas railway car loadings on the same basis of comparison showed a decrease of more than 20 per cent. Tonnage through the Panama Canal showed a small decrease in the fiscal year 1938, compared with 1937, but nothing like that in railway tonnage in the same period. Passenger traffic by air continued to increase in 1938, Department of Commerce reports showing an increase in the first nine months of that year of about 14 per cent in plane-miles, and more than 17 per cent in the number of air passengers carried.

Mediation Board A Bit Disgusted

The National Mediation Board in its annual report directs attention to the fact that of the 241 cases decided during the fiscal year, 138 involved disputes among employees, as compared to 110 involving disputes between carriers and employees; two cases were interpretations of agreements previously mediated. It frankly comments upon the fact that entirely too much of the board's time is being used in settling differences between labor organizations competing for the right to represent particular crafts or classes of employees. "Unfortunately," it says, "the greatest need for the holding of such hearings has grown out of disputes over membership between two organizations, national in scope, which disputes would never have arisen had the organizations involved exerted the same efforts to agree with one another over their proposed jurisdiction that the Act expects carriers and employees to exert in the making of labor agreements." A board of this sort could hardly be expected to use stronger expressions in pointing out an abuse of this kind. Certainly, when a long suffering body is goaded to the point where it is forced to make such comments, it is high time for some of the labor leaders to mend their ways.

Monopoly Investigation

What was advocated a couple of years ago to be a trust busting expedition, but which is now commonly referred to in the news press as a monopoly investigation, has become, according to the members of the Temporary National Economic Committee, an economic study. This committee, by the way, is made up of representatives of the legislative and the executive branches of the government in equal numbers; this is said to be the first time a committee of Congress has been so constituted. It started off early in December with a dramatic presentation by several of the committee's economists of the economic problem in this country; this has followed by hearings on the use of patents in the automobile and glass container industries. The members of the committee insist that there is to be no "burning of witches." They point to a resolution which the committee recently adopted, reading that "it is the unanimous sense of this committee that its function and purpose is to collect and analyze through the medium of reports and published hearings, available facts pertaining to the items specified in Public Resolution 113 (Seventy-fifth Congress) in an objective, unbiased and dispassionate manner, and that it is the purpose of the committee to pursue its work solely from this point of view." Rumor has it that bills are already being prepared to amend the patent law. Apparently, however, the committee as such has no part in this and may be expected to oppose such bills until sufficient facts have been gathered to chart a wise course. Business has been taken for so many rides in recent years that it is not strange that the widely announced good intentions of the T. N. E. C. are being viewed with a certain degree of skepticism in some quarters. The good intentions of the more conservative members of the group, however, can hardly be questioned.

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Among the Clubs and Associations

NEW ENGLAND RAILROAD CLUB.—"How Can We Avoid Government Ownership of Railroads" was discussed by Samuel O. Dunn, chairman of the board of the Simmons-Boardman Publishing Corporation, at the January 10 meeting.

CENTRAL RAILWAY CLUB OF BUFFALO.—The fiftieth annual dinner of the Central Railway Club of Buffalo was held on Thursday evening, January 12, at the Hotel Statler, Buffalo, N. Y. The guest of honor was the Honorable Joseph R. Hanley, state senator, New York.

PACIFIC RAILWAY CLUB.—F. K. Vial, vice-president of the Griffin Wheel Company, Chicago, discussed The Manufacture and Maintenance of Wheels at the meeting held on January 13. A sound motion picture, "The Story of the Chilled Car Wheel," was also presented.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—Victor Willoughby, vice-president of the American Car and Foundry Company, New York, presented a paper, illustrated with lantern slides, on Refrigeration in Transit at the meeting of the association held on January 17, at the Hotel Mayfair, St. Louis, Mo.

TORONTO RAILWAY CLUB.—At the January 23 meeting, to be held at 7:45 p. m., at the Royal York Hotel, Toronto, I. I. Sylvester, special engineer of the Canadian National Railways, will discuss The Application of the Diesel Locomotive to Switching Service. Directors and officers for 1939 will also be elected at this meeting.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—"Outside Looking In" was the title of the subject chosen by the speaker, Hugh K. Christie, manager, Transportation Equipment Division, Whiting Corporation, for presentation at the meeting on January 17 at the Ansley Hotel Roof Garden, Atlanta, Ga. The Yale & Towne motion picture, "Material Handling Equipment," also was shown.

RAILWAY CLUB OF PITTSBURGH.— J. J. Cornwell, general counsel, Baltimore & Ohio, Baltimore, Md., will discuss "Troubles of the Railroads" at the meeting to be held at 8 p.m. at the Fort Pitt Hotel, Pittsburgh, Pa., on January 26.

EASTERN CAR FOREMAN'S ASSOCIATION.—"Storage Battery Power," illustrated by sound moving pictures of The Edison Company, was the subject discussed at the January 13 meeting.

NEW YORK RAILROAD CLUB.—"The Story of the Chilled Car Wheel" will be presented by F. H. Hardin, president of the Association of Manufacturers of Chilled Car Wheels, at the meeting to be held on January 20 at 7:45 p.m. at the Engineering Societies building, New York. Contributory remarks will be made by C. B. Peck, managing editor, *Railway Mechanical Engineer.*

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION. — R. P. Ives, Westinghouse Air Brake Company, 3400 Empire State building, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION. — J. F. Gettrust, P. O. Box 5522, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—C. E. Davies, 29 West Thirty-ninth street, New York. Annual meeting December 5-9. Engineering societies building, New York.

RAILROAD DIVISION.—Marion B. Richardson, P. O. Box 205, Livingston, N. J.

MACHINE SHOP PRACTICE DIVISION.—J. R. Weaver, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

MATERIALS HANDLING DIVISION. — F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.

OIL AND GAS POWER DIVISION. — M. J. Reed, 2 West Forty-fifth street, New York.

FUELS DIVISION.—A. R. Mumford, N. Y. Steam Corp., 130 E. Fifteenth st., New York.

ASSOCIATION OF AMERICAN RAILROADS. — J. M. Symes, vice-president operations and maintenance department, Transportation Building, Washington, D. C.

OPERATING SECTION. — J. C. Caviston, 30 Vesey street, New York.

MECHANICAL DIVISION.—V. R. Hawthorne, 59 East Van Buren street, Chicago.

PURCHASES AND STORES DIVISION.—W. J. Farrell, 30 Vesey street, New York.

MOTCR TRANSPORT DIVISION. — George M. Campbell, Transportation Building, Washington, D. C.

CANADIAN RAILWAY CLUB. — C. R. Crook, 4468 Oxford avenue, Montreal, Que. Regular meetings, second Monday of each month, except in June, July and August, at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS. — J. J. Sheehan, 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July and August, Hotel Mayfair, St. Louis, Mo.

CAR DEPARTMENT OFFICERS' ASSOCIATION.—Frank Kartheiser, chief clerk, Mechanical Dept., C. B. & Q., Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago, Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago.

CAR FOREMEN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS AND SOUTH OMAHA INTERCHANGE.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month at 1:15 p. m.

CENTRAL RAILWAY CLUB OF BUFFALO. — Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

EASTERN CAR FOREMEN'S ASSOCIATION. — Roy MacLeod, New York, New Haven & Hartford, New Haven, Conn. Regular meetings, second Friday of each month, except May, June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION. — R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August, and September, at Hotel Severin, Indianapolis, at 7 p. m.

INTERNATIONAL RAILWAY FUEL ASSOCIATION. — See Railway Fuel and Traveling Engineers' Association.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—F. T. James (President), general foreman, D. L. & W., Kingsland, N. J.

INTERNATIONAL RAILWAY MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

MASTER BOILER MAKERS' ASSOCIATION. — A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

NEW ENGLAND RAILROAD CLUB. — W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September, at Hotel Touraine, Boston.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July, August, September, at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION. — E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Midway Club rooms, University and Prior avenue, St. Paul.

PACIFIC RAILWAY CLUB. — William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Calif., alternately, excepting June in Los Angeles and October in Sacramento.

RAILWAY CLUB OF GREENVILLE—Sterle H. Nottingham, Greenville, Pa. Regular meetings, third Thursday in month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

RAILWAY FIRE PROTECTION ASSOCIATION.—P. A. Bissell, 40 Broad St., Boston, Mass.

RAILWAY FUEL AND TRAVELING ENGINEER'S ASSOCIATION.—T. Duff Smith, 1255 Old Colony building, Chicago.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—P. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, Association of American Railroads.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

TORONTO RAILWAY CLUB.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto, Ont.

TRAVELING ENGINEERS' ASSOCIATION.—See Railway Fuel and Traveling Engineers' Association.

WESTERN RAILWAY CLUB.—W. L. Fox, executive secretary, Room 822, 310 South Michigan avenue, Chicago. Regular meetings, third Monday in each month, except June, July, August and September.

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NEWS

Automatic Stoker Case Is Again Postponed

UPON the recommendation of its chief counsel the Interstate Commerce Commission has postponed the effective date of its automatic stoker order from December 15 to February 1, 1939. The action was taken because of a suit now pending in the United States District Court for the Northern District of Ohio in which the carriers are attempting to have the commission's order set aside.

Another Six-Months Reprieve for Arch-Bar Trucks

FREIGHT cars equipped with arch-bar trucks will be accepted in interchange at least until July 1, 1939, as a result of a recent decision of the Association of American Railroads board of directors to extend the deadline another six months. Similar action was taken last July when the deadline was moved up to January 1, 1939. At that time J. J. Pelley, president of the A. A. R., said that only about two per cent of the total railroad-owned cars, which are regarded as suitable for service or worth repairing, were equipped with arch-bar trucks.

Roads Could Spend Billion Each Year

DECLARING that the railroads in the next five years could profitably expend one billion dollars annually for new freight cars, and locomotives, repair of existing equipment and improvement in track and facilities, R. V. Fletcher, vice-president and general counsel of the Association of American Railroads, on December 12, discussed before the Senate Finance Committee the advisability of amending the tax laws so as to permit such expenditures being taken into consideration in computing taxes to be paid by the railroads.

Taxes, Judge Fletcher said, place a heavy burden on the railroads especially those imposed by the states. In some of the states, he said, the same consideration is not given to the railroads as that given to other property owners. "If the federal government in determining the taxes on railroad property would take into consideration amounts which the carriers spend on rehabilitation of property," he suggested, "then that policy might have some effect on the states."

For the rehabilitation of equipment and track alone Judge Fletcher said, that according to conservative estimates, at least $600,000,000 could be spent annually in the next five years and that the amount might total $775,000,000.

Judge Fletcher told the committee that to reduce to six per cent the number of freight cars which are in need of repair, the cost would be $53,614,000. He estimated that the railroads should install 100,000 new freight cars annually in the next five years. For the seven year period—1923 to 1929—the railroads built or purchased 114,832 new freight cars annually. From 1930 to 1935 they bought only 21,000 annually. He estimated that the acquisition of 100,000 new freight cars each year for the next five years would cost $300,000,000.

Judge Fletcher also said that to reduce to ten per cent the number of locomotives in need of repair would cost approximately $25,000,000 or $7,000 per locomotive. He also said the railroads should install 2,000 new locomotives annually in the coming five year period the cost of which would be $200,000,000. In the seven years from 1923 to 1929 inclusive, the number of new locomotives acquired by the railroads was 2,075 annually. From 1930 to 1935, inclusive, he said, the railroads only purchased 174 locomotives annually, although, due to a stimulation in business early in 1937, they added 373 locomotives in that year.

Railroads Save Fuel

A NEW high record in fuel efficiency was made by the railroads of the United States in the first nine months of 1938, according to reports received by the Association of American Railroads. This was true both for freight and passenger service.

For each pound of coal consumed in freight service the railroads in the first nine months of 1938 hauled 8.8 tons of freight and equipment a distance of one mile, the best record in fuel efficiency that has ever been established in the freight service. This was an increase of 5.2 per cent in fuel efficiency compared with 1920, when the average for the entire year was 5.8 gross tons hauled one mile for each pound of coal used. In the first nine months of 1937 the average was 8.7 tons, and in the same period in 1936 it was 8.4 tons.

The railroads in the first nine months of 1938 used in passenger service 14.7 lb. of coal in order to haul a passenger-train car one mile which also was a new record. In the same period last year 14.9 lb. were used and in the same period in 1936 the average was 15.3 lb. Fuel efficiency in the passenger service, using the same basis of compilation, was 22 per cent greater in the first nine months of 1938 than in the same period of 1920 when the average was 18.8 per thousand gross ton-miles.

Contemplated Improvements and Equipment Purchases

St. Louis-San Francisco.—Trustees of the St. Louis-San Francisco have asked the federal district court for authority to spend $3,490,534 for roadway and mechanical improvements in 1939. Expenditures for mechanical improvements total $1,128,179 and include the purchase of five mountain-type locomotives for freight service.

Pittsburgh & West Virginia.—This company has applied to the Interstate Commerce Commission for authority to sell to the Reconstruction Finance Corporation or have the R. F. C. guarantee the payment of $1,500,000 of equipment trust certificates, the proceeds to be used to purchase 100 steel box cars and 600 50-ton, steel hopper cars. The total cost of the purchase would be about $1,675,000, and the issue of equipment trust certificates will cover 90 per cent of the cost.

Illinois Central.—This company has approved a budget of $780,000 for the conversion of thirteen 2-10-2 type locomotives into 4-8-4 type locomotives at the rate of one a month during 1939. The work will be done at the company's shops, at Paducah, Ky.

Southern. — The Interstate Commerce

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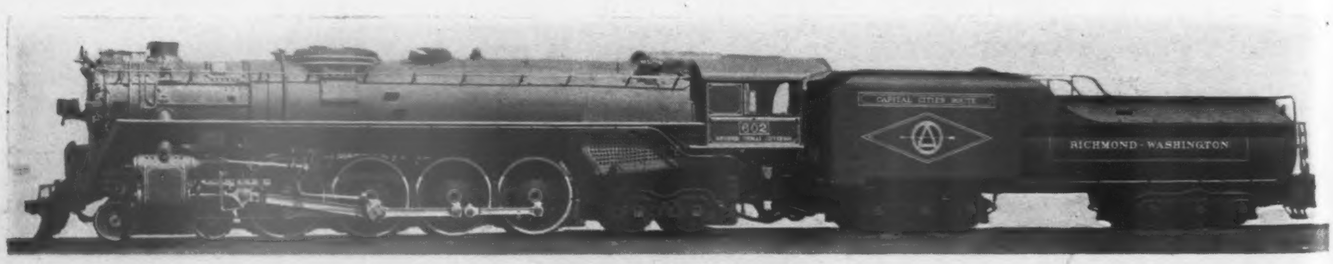

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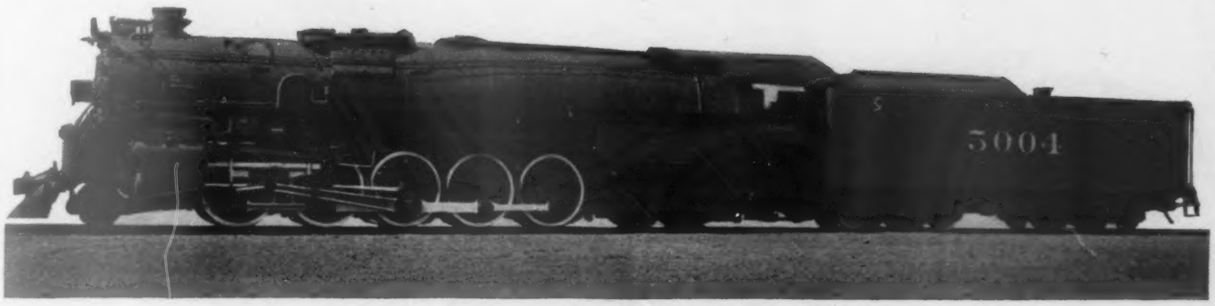
One of six "Governor" class passenger locomotives built for the Richmond, Fredericksburg & Potomac by the Baldwin Locomotive Works—The total engine weight is 406,810 lb. and the tractive force 62,800 lb.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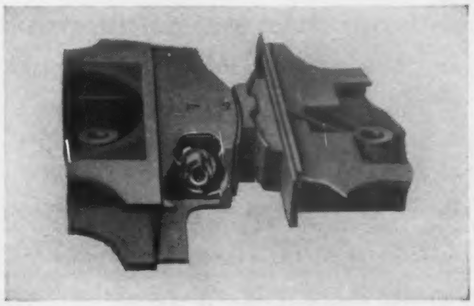


Commission, Division 4, has authorized the Southern to assume liability for $6,000,000 of its four per cent equipment trust certificates. At the same time authorizing the Reconstruction Finance Corporation to purchase these certificates for itself at a price not in excess of their principal amount. The proceeds of the certificates will be used to purchase approximately 2,400 all-steel freight cars and 25 70-ft. all-steel express cars, costing an estimated $6,000,000.

Atchison, Topeka & Santa Fe.—The Santa Fe has authorized the purchase of 30 Diesel electric switching locomotives, some of 600 hp. and some of 900 hp., at an estimated cost of more than $2,250,000. The purchase of additional equipment will be considered later.

Chicago & North Western.—The C. & N. W. has asked the Federal district court at Chicago for authority to purchase new streamline equipment and Diesel power units for two "400" trains at a cost of $2,320,000, $720,000 for the locomotive and $1,600,000 for 10 cars. Each train will consist of a locomotive and 10 cars, including a tap room-lounge car, 4 coaches, 1 diner, 3 parlor cars, and 1 observation-club car. The Diesel power equipment for each train is to consist of a double unit, with double-end control, and be capable of generating 4,000 hp. and of attaining a maximum speed of 120 m.p.h.

1939 Brings New Hope, Says Pelley

"Approach of the year 1939 brings to the railroads of the United States renewed hope for a solution of the critical financial situation which has faced them in the past 12 months," said J. J. Pelley, president of the Association of American Railroads, in a December 30 statement summarizing the performance of the railroads in 1938.

"At no time," Mr. Pelley went on, "has there been a greater public appreciation of their problems than now or a more earnest desire to formulate some plan that will solve the desperate situation in which the rail carriers find themselves. With the coming of the new year, railroad managements hope that early action will be taken by Congress and the state legislatures looking toward development of a national transportation policy which will place all agencies of transportation upon an equality in matters of regulation, taxation and subsidies; recognize railroads as a business entitled to the same chance to earn a living as any other business and enable the railroads to re-establish their credit.

"The railroads in the past twelve months have continued to furnish to the public the highest standard of transportation, so far as dependability and efficiency are concerned, ever attained by them. Not only were new high records made in 1938 by the railroads of the United States in the average speed of both freight and passenger trains and in fuel conservation, but there also were numerous other increases in operating efficiency as compared with 1937.

"From a financial viewpoint, however, 1938 was one of the most disappointing years that has ever been experienced. . . . We estimate that after fixed charges have been met, Class I railroads in 1938 will have a net deficit of $125,000,000, compared with a net income of $98,000,000 in 1937. The net deficit in 1938 was the greatest for any year on record except in 1932 when it was $139,000,000. While complete reports for the year are not yet available, preliminary reports indicate that the railroads will have a net railway operating income, before fixed charges, of $362,000,000, or a return of 1.39 per cent on their property investment. In 1937 it was $590,000,000, or a return of 2.26 per cent.

"Loading of revenue freight in 1938 totaled 30,362,000 cars. In only two years —1933 and 1932—since the compilation of these reports began in 1918, has this volume of traffic been smaller. . . . Passenger traffic, too, in 1938 was less than in any year since 1935, amounting to 21,800,000,000 passenger miles. This was a reduction of 11.6 per cent compared with 1937 and a reduction of 18.7 per cent compared with 1930.

"Partly because of the serious financial condition of the railroads and partly because of the fact that the volume of traffic could be handled without difficulty with existing equipment, the railroads in 1938 installed only 16,266 new freight cars. In 1937, there were 75,058 new freight cars put into service and in 1936 the number was 43,941. Class I railroads in 1938 also put in service 162 new steam locomotives and 103 electric and Diesel-electric locomotives compared with 373 steam and 77 electric and Diesel-electric locomotives in 1937 and 87 steam and 34 electric and Diesel-electric locomotives in 1936.

"New freight cars on order on December 1, 1938, totaled 4,335, the smallest number on order on that date in any year since December 1, 1934. Class I railroads on December 1 had only 17 steam locomotives and 39 electric and Diesel-electric locomotives on order compared with 131 steam and 30 electric and Diesel-electric locomotives on order on the same day one year ago. This Association estimates that if their financial condition would permit, the railroads of the United States could profitably install 100,000 new freight cars and 2,000 new locomotives annually in the next five years in order to replace older equipment with the view of bringing about a further increase in operating efficiency."

(*Turn to next left-hand page*)

New Equipment Orders and Inquiries Announced Since the Closing of the December Issue

LOCOMOTIVE ORDERS

Company	No. of Locos.	Type of Loco.	Builder
Norfolk & Western	10	Y-6 Mallet	Company Shops
Reading-Central of New Jersey[1]	9	600-hp. Diesel-electric	Electro-Motive Corporation
	4	600-hp. Diesel-electric	American Locomotive Co.
	1	600-hp. Diesel-electric	Baldwin Locomotive Works
	1	600-hp. Diesel-electric	Fairbanks, Morse & Co.
Union Pacific	1[2]	4,000-hp. Diesel-electric	Electro-Motive Corporation

FREIGHT-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
Norfolk & Western	500	40-ft. steel box	Pressed Steel Car Co.
	100	50-ft. steel box	Greenville Steel Car Co.
	35	Covered hopper	Company Shops
	750	55-ton steel hopper coal	Bethlehem Steel Company
	750	55-ton steel hopper coal	Virginia Bridge Company
Wheeling & Lake Erie	400	60-ton hopper	Ralston Steel Car Company
U. S. Navy	39	50-ton flat	Major Car Company

FREIGHT-CAR INQUIRIES

Canadian National[3]	2,000	Box	....
Illinois Central	1,000	50-ton gondola	....
Lehigh & New England	100	50-ton hopper	....

PASSENGER-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
New York Central Pennsylvania		See footnote 4	

PASSENGER-CAR INQUIRIES

Atlantic & Western	1	Rail car with gas-mech. drive	....
Canadian National	10	Baggage	....
	5	Mail-express	....

[1] Ten of the switchers will be used on the Central of New Jersey and five on the Reading. Authorization of this purchase was reported in the December *Railway Mechanical Engineer*.

[2] For use in its thirteen-car streamliner the "City of Los Angeles." Except for improvements in details and the fact that each of the four engines in the locomotive will have 1,000 hp. instead of 900 hp., the new locomotive will have the same appearance and construction principles as are embodied in the 5,400-hp. locomotives now handling the new "City of Los Angeles" and "City of San Francisco" streamline trains. The 5,400-hp. locomotives have two 900-hp. engines in each of three units.

[3] The Canadian National is also planning to construct in its own shops, during 1939, some caboose and refrigerator cars.

[4] Eighty light-weight streamline room cars are being constructed by the Pullman-Standard Car Manufacturing Company, Chicago, for the Pullman Company for operation on the New York Central and the Pennsylvania. On the New York Central the 40 cars will be used on the Detroiter, the Commodore Vanderbilt, the Water Level and the Southwestern. The cars, which will be delivered by July 1, are as follows:

	N. Y. C.	Pa.
10 roomette, 5 double bedroom	8	6
18 roomette	8	18
6 double bedroom, buffet, lounge	6	..
1 drawing room, 1 compartment, 2 double bedroom, observation, buffet	3	..
13 double bedroom	6	4
2 drawing room, 4 compartment, 4 double bedroom	9	6
12 duplex	..	6
	40	40

Equipment Repairs and Improvements

The Wabash has been authorized by the Federal district court to install automobile loading racks in 200 freight cars and make general repairs on 100 of the cars.

The Chesapeake & Ohio recently bought 6,400 tons of fabricated steel car parts for use in repairing freight cars at its Russell, Ky., car shops.

The Pennsylvania has ordered 1,045 tons of sheets from the Carnegie-Illinois Steel Corporation. The railroad will use the steel for general repairs and maintenance of equipment at its Altoona, Pa., shops.

The Delaware, Lackawanna & Western is placing orders for materials for use on 200 freight cars at its Keyser Valley shops, Scranton, Pa.

Collision at Tortuga, Calif.

A HEAD-ON collision between two passenger trains occurred on September 2, 1938, on the Southern Pacific at Tortuga, Calif., in both of which trains certain cars of lightweight alloy-steel construction were involved. The report of the director of the Bureau of Safety of the investigation of this accident, which has been issued under date of December 2, deals with this aspect of the accident as well as with the circumstances relating to its cause.

The accident was a head-on collision between two passenger trains, No. 44 eastbound, which was standing on a siding, and No. 5 westbound, which entered the siding at between 30 and 40 miles an hour when the switch was thrown directly in front of the approaching train. The accident resulted in the death of eight passengers and three employees and in the injury of 132 passengers, three railway mail clerks, three Pullman employees and one train-service employee.

In the investigation it was disclosed that "all of the fatalities to passengers occurred in the third car of No. 44, which car was the forward section of a two-car articulated unit of lightweight streamline design. The car was telescoped a distance of 18 ft., or slightly more than one-fourth of its total length, sustaining far more serious damage than either of the two cars ahead of it. In No. 5, the car which sustained the greatest damage was the fourth car, which was practically demolished and which was likewise a lightweight, streamline car.

"In both of the trains involved in this accident these lightweight cars were being operated in association with heavy, all-steel, standard equipment, the lightweight cars being the third, fourth and fifth cars in the 11-car eastbound train, and the fourth car in the westbound 14-car train. All other cars in each of the two trains were of heavy, all-steel, standard type, thus placing the lightweight cars between the standard cars and ahead of the heavier diners, lounge cars and sleepers.

"Obviously, in the collision, the most violent impact occurred between the two locomotives, which were practically demolished and a great amount of the destructive shock was thus dissipated. The destructive shock then progressed backward, carrying to the fifth car in No. 5 and to the third car in No. 44, there being no damage to equipment in either train back of these points. There was considerable damage to the forward standard cars in each train, further dissipating the destructive force, but the first lightweight car in each train suffered the greatest damage. It is evident that the collapse of these cars further absorbed the destructive shock to such an extent that but little damage occurred beyond them."

In concluding his report the director of the Bureau of Safety recommended that "railroad officials give serious consideration to the discontinuance of operation of so-called lightweight cars between or ahead of standard cars unless and until the strength of construction has been determined by suitable tests to be substantially the same as that of other cars with which they are associated.

An editorial in the December 31 issue of the Railway Age commenting on this report says: "The fact that the superior strength of the alloy steels and the lightness of the aluminum alloys make it possible to build cars of lighter weight with both of these groups than with carbon steel . . . does not justify bundling these . . . dissimilar materials into a single category for which are inferred inferior qualities of strength and safety as compared with the older carbon steel. To do so implies a belief that weight is synonymous with strength. Such a conclusion overlooks the fact that every pound of weight added to a structure contributes to the destructive energy stored in it when in motion. Each combination of material, type of design and method of fabrication must be studied individually, and this applies as much to structures of carbon steel as to those of any of the other materials.

"Certainly the evidence presented in the report is utterly inadequate as the basis for such a general conclusion as the public is likely to infer from the recommendation in the report. Indeed, it does not adequately answer important questions concerning the specific combination of material, design and fabrication involved in this case . . . .

"Each design, of whatever material, should stand on its own ability to meet fully the Railway Mail Service Specifications. With understanding use and skilled distribution of his material, together with the assurance of the experienced designer that his structure has integrity as a unit, advantage can be taken of the superior properties of the new materials of construction for reducing weight without sacrificing strength. A failure in a single instance, from whatever cause, is insufficient reason for discouraging continued progress in lightweight passenger-car design."

Supply Trade Notes

S. A. CRABTREE and W. J. Jack have been appointed assistant district sales managers of the Republic Steel Corporation in the Chicago territory.

◆

PAUL D. CURTIS has been elected vice-president of the Marquette Railway Supply Co., Chicago, following the death of Floyd L. Ingraham, president.

◆

HARRY M. FRANCIS, assistant general manager of sales in the Cleveland, Ohio, office of the American Steel & Wire Co., subsidiary of the United States Steel Corporation, has been appointed assistant vice-president of sales.

◆

WALTER B. STRONG, manager of the export division of the Worthington Pump & Machinery Corporation, Harrison, N. J., has been appointed assistant general sales manager. Mr. Strong will continue to have general supervision of export sales and be identified with certain phases of domestic sales.

◆

THOMAS TOBY, who was formerly associated with the National Lock Washer Company, Newark, N. J., has become affiliated with the Pittsburgh Screw & Bolt Corporation as a sales representative in the New York office.

◆

ALAN E. ASHCRAFT, vice-president of Fairbanks, Morse & Company, with headquarters at Beloit, Wis., has been appointed vice-president in charge of all the company's operations in seven plants, with headquarters at Chicago.

◆

A. J. HAZLETT, formerly president of the Eastern Rolling Mill Company, Baltimore, Md., has been appointed manager of the strip-sheet sales department of the Jones & Laughlin Steel Corporation, Pittsburgh, Pa., to succeed William Miller, who has been appointed district manager of the Detroit office.

◆

V. H. DEARLE has been appointed assistant Detroit district manager of the Carboloy Company, Inc., 2985 E. Jefferson avenue, Detroit, Mich. Mr. Dearle has been with the Carboloy Company since its formation in 1928 and is a charter member of the American Society of Tool Engineers.

◆

G. CLIFFORD LIVEZEY has been elected president and general manager, and Charles H. Atherholt, vice-president, of the Metals Coating Company of America, Philadelphia, Pa. Mr. Livezey was formerly with W. S. Hurst & Company, certified public accountants and industrial engineers.

(*Turn to next left-hand page*)

THE HOLLAND COMPANY, Chicago, has entered into a contract with August W. L. Hartbauer, whereby it will handle the sales of refrigerator-car hatch-closure mechanisms and Cap-Seal cushion rubber gaskets under Hartbauer patents issued and pending.

CHARLES E. BRINLEY, acting vice-president with executive powers, of the Baldwin Locomotive Works, has been elected president to fill the vacancy caused by the resignation of George H. Houston last August. William H. Harman, vice-president and general manager of the Baldwin-Southwark Corp., has been elected vice-president in charge of sales, and Robert S. Binkerd has resigned as vice-president and director of sales.

Charles E. Brinley, who has been associated with the American Pulley Company of Philadelphia, Pa., since 1901 and has served as its president since 1919, was born in Philadelphia in 1880 and received his higher education as a mechanical engineer at Yale University, receiving his bachelor degree in 1900 and a degree from the Sheffield Scientific School in 1901. He is a member of the American Society of Mechanical Engineers, a director of a number of important industrial, public utility and insurance companies and a trustee of the Drexel Institute of Technology. While his own connection with Baldwin is of recent origin, Mr. Brinley's father, before he founded the American Pulley Company, is reported to have served as a chemist with the Midvale Company, now a Baldwin subsidiary, in its early days. Mr. Brinley was elected a director and member of the executive committee of the Baldwin Locomotive Works on the occasion of its reorganization under Section 77B of the Federal Bankruptcy Act earlier this year.

C. E. Brinley

William H. Harman, who has been elected vice-president in charge of sales of the Baldwin Locomotive Works, will continue as vice-president also of Baldwin-Southwark Corporation. Mr. Harman was, for 21 years, a member of the staff of R. D. Wood & Co., and, for some time prior to his leaving that company in 1915, held the position of sales manager of the hydraulic machinery division. From 1915 to 1929 he was president of the Southwark Foundry & Machine Co., and when this company became, in 1929, part of the Baldwin group under the corporate name of Baldwin-Southwark Corporation, he became vice-president and general manager. Mr. Harman is a member of the American Society of Mechanical Engineers, is president of the Diesel-Engine Manufacturers' Association, and a member of the executive committee of the Hydraulic Machinery Manufacturers' Association.

ROBERT S. BINKERD has resigned as vice-president and director of sales of The Baldwin Locomotive Works, and is planning to take a short rest before taking up other work. Graduating from Yale in 1904, after considerable experience with different types of civic associations, Mr. Binkerd in 1917 became assistant to the chairman of the old Railway Executives' Advisory Committee, which later became the Association of Railway Executives. In 1923 he became associated with the Eastern President's Conference, being appointed vice-chairman of the committee on public relations. From 1927 to 1929 he was a partner with the stock exchange house of Jas. H. Oliphant & Co., of New York and Chicago. For the next several years he was retained in connection with various matters by different companies, including a number of banks and trust companies. During this period he also was one of the arbitrators who determined the value of the minority stock of the Michigan Central Railroad in connection with the New York Central unification plan. In the spring of 1931 he made a study of the economics of the use of motive power and in July of that year became associated with the Baldwin Locomotive Works.

R. S. Binkerd

KENNETH J. TOBIN, assistant vice-president for the Camel Sales Company, Chicago, has been appointed vice-president, and A. G. Dohm, assistant vice-president has also been appointed vice-president. L. F. Duffy has been appointed assistant vice-president.

THE OHIO BRASS COMPANY, Mansfield, Ohio, has announced that Claude R. Kingsbury, Seattle, Wash., has taken over the territory formerly handled by J. W. Watkins, who is leaving the employ of the company. Mr. Kingsbury has been with the company since 1927.

HOWARD V. CLARK, general manager of the order division for the Carnegie-Illinois Steel Corporation, Pittsburgh, Pa., has been appointed manager of sales of the sheet division of the corporation's general sales department. Mr. Clark succeeds Avery C. Adams, resigned.

HARRY F. KNAPP who has been associated since 1903 with the Carnegie-Illinois Steel Corporation, a subsidiary of the United States Steel Corporation, serving since 1931 as manager of sales of the Washington district sales office, has been appointed manager of sales, special accounts, with headquarters at Washington, D. C., and Andrew J. Snow, who joined

* * *

The New Irvin Works of the Carnegie-Illinois Steel Corporation Dedicated on December 15

The chief units of the plant are an 80-in. hot strip mill, an 84-in. tandem cold reducing sheet mill, and a 42-in. tandem cold reducing tin mill, supplemented by the necessary annealing furnaces, picking and tinning departments. The mills are electrically operated and have an annual capacity of 600,000 tons

the company in 1912 and has spent his entire business career in that service, has been promoted from assistant manager of the Washington district sales office to manager of sales of that office.

W. W. SEBALD, vice-president and assistant general manager of The American Rolling Mill Company, Middletown, Ohio, has been elected a director of the company, to fill the vacancy on the Armco board of directors caused by the death of J. H. Frantz, of Columbus.

THE ASSOCIATION OF MANUFACTURERS of Chilled Car Wheels has established a research project at Battelle Memorial Institute on chilled irons for use in car wheels, according to an announcement by F. H. Hardin, president of the association, and Clyde E. Williams, director of the Battelle Memorial Institute. The work will comprise a critical study of the material in current use and of new compositions in the iron carbon group of metals.

THOMAS R. COOK, manager of inspection and field service of the Baldwin Locomotive Works, Philadelphia, Pa., has resigned to enter the service of Coverdale & Colpitts, consulting engineers, 120 Wall street, New York. It was during former association with Coverdale & Colpitts that Mr. Cook made the initial study of the relation of age to the cost of locomotive maintenance. Much of his attention while with Baldwin was directed to the study of motive-power economics.

AVERY C. ADAMS, manager of sales, sheet division, of the Carnegie-Illinois Steel Corporation, Pittsburgh, Pa., has resigned to become vice-president and assistant general manager of sales of the Inland Steel Company, Chicago. Mr. Adams was employed by the Trumbull Steel Company, Warren, Ohio, in various capacities from 1919 to 1928. He resigned from this company as assistant general manager of sales in May of that year to become manager of the tin plate division of the Republic Steel Corporation. In July of the same year, Mr. Adams entered the employ of the General Fireproofing Company in Youngstown, Ohio, as vice-president in charge of sales. He resigned from the latter position in June, 1936, to become manager of sales of the sheet division of the Carnegie-Illinois Steel Corporation, Pittsburgh, Pa.

V. B. EMRICK, representative of the Westinghouse Air Brake Company, at Washington, D. C., has been appointed southeastern district manager, with headquarters at Washington. He succeeds Robert Burgess, who has retired after 45 years of continuous service with the company. Mr. Emrick, after serving for nine years with the Atchison, Topeka & Santa Fe as fireman and locomotive engineman, was employed by the Locomotive Stoker Company successively as mechanical expert and representative. He entered the employ of the Westinghouse Air Brake Company in 1929 as mechanical expert, at St. Paul, Minn. One year later he was transferred to the St. Louis, Mo., office and in May, 1938 became representative at Washington.

THE AMERICAN LOCOMOTIVE COMPANY, on December 13, received from the people of Schenectady, N. Y., under the sponsorship of the Chamber of Commerce of that city, a plaque commemorating the establishment of the locomotive-building plant there in 1848. A unique feature of the exercises at Schenectady was the presentation of two prizes for the best locomotive models made by residents of that city at a dinner in the evening at the Van Curler Hotel. President William C. Dickerman of the American Locomotive Company, in responding to greetings and well wishes, spoke on "Ninety Years of Locomotive Building."

The Schenectady plant became a part of the American Locomotive Company in 1901 when the Schenectady Locomotive Works and seven other locomotive building concerns were merged under that name. Two more companies were added later.

Obituary

FLOYD L. INGRAHAM, president of the Marquette Railway Supply Company, Chicago, died in that city on November 28, of heart failure.

HORACE B. SPACKMAN, retired vice-president of the Lukens Steel Company, Coatesville, Pa., died on December 11 of a heart attack at the age of 77. Mr. Spackman was born in Caln township, near Coatesville, on October 21, 1862, and attended grade school there and later John-

Horace B. Spackman

son's Academy, near Guthriesville. In January, 1881, Mr. Spackman started work with the Lukens Steel Company as an office boy and in 1892 was appointed purchasing agent of the company. He became vice-president in 1900, retiring from active duty in May, 1929, after more than 48 years of continuous service with the company. From 1897 until his death he served as a director of the Lukens Steel Company.

RUSSELL B. TEWKSBURY, chairman of the board of The Oster Manufacturing Company, Cleveland, Ohio, died on January 1, at his winter home in Sarasota, Florida, at the age of 79 years. Mr. Tewksbury was one of the founders of this company in 1893. In 1898, Mr. Tewksbury became the president of the company, which position he retained until five years ago when he became chairman of the board. He was also a director of the Cleveland Tractor Company and the Electric Railway Improvement Company, of Cleveland.

GEORGE THOMAS COOKE, president of the American Railway Products Company, Darien, Conn., died on November 8. Mr. Cooke was born at Chicago, on May 28, 1883. He began his career in 1901 as ap-

George Thomas Cooke

prentice draftsman with the Pullman Company. In 1903 he served as chief draftsman at the Pullman Calumet shops, and from 1906 to 1911 was mechanical inspector. He served from 1911 to 1917 as southern manager of the Chicago Car Heating Company, Atlanta, Ga., and then went to New York as eastern manager of the Vapor Car Heating Company. From 1918 to 1925 he was vice-president of the Union Metal Products Company and during the latter year became president of the American Railway Products Company. Mr. Cooke then began the manufacture of devices of his own invention.

G. LARUE MASTERS, vice-president in charge of sales of the National Lock Washer Company, Newark, N. J., whose death on October 25 was reported in the November issue of the *Railway Mechanical Engineer*, started his early career in the paper business. He later served as manager and then as president of Unger Brothers, silversmiths. During the World war, Mr. Masters worked with the aircraft industry and after the war, became associated with the National Lock Washer Company in the car equipment department and later became vice-president in charge of all sales of the company. Some years ago, he was elected a director of the company and was serving as a director and vice-president at the time of his death.

FRANK D. MILLER, president and general manager of the National Brake Company, Inc., Buffalo, N. Y., died on December 6, at Buffalo General Hospital after a short illness. Mr. Miller was born at Tunk-

(*Continued on second left-hand page*)

hannock, Pa., 60 years ago. He was educated at Wyoming Seminary and Princeton University. In 1905 he went to Buffalo and became associated with the National Brake Company and from 1910 to the time of his death had been president and general manager of that company.

◆

LEWIS T. CANFIELD, who retired as vice-president of the Cardwell Westinghouse Company, Chicago, in 1936, died in that city on December 3, after a short illness. Mr. Canfield was born on December 3, 1861, and entered railway service in 1879, in the shops of the Indianapolis, Cincinnati & Lafayette, subsequently serving with its successor, the Indianapolis, Cincinnati

Lewis T. Canfield

& St. Louis, which later became a part of the Cleveland, Cincinnati, Chicago & St. Louis. In 1889, he entered the employ of the Chicago, Rock Island & Pacific, and for nine years was foreman and division master car builder. In 1898, Mr. Canfield resigned to become associated with the Standard Railway Equipment Company, and on April 15 of the following year, was appointed master car builder of the Delaware, Lackawanna & Western. He remained in this position until December, 1902, when he entered the employ of the American Car and Foundry Company, where, until 1910 he was in charge of car building in Manchester, England, and in Italy. In 1910, he resigned to become vice-president of the Cardwell Westinghouse Company.

◆

WILLIAM R. SEIGLE, chairman of the board since 1929 and research director of the Johns-Manville Corporation, died at St. Mary's Hospital, Rochester, Minn., on December 27.

◆

FRANK N. HOFFSTOT, founder and former president of the Pressed Steel Car Co., Inc., Pittsburgh, Pa., died on December 25 at his home in New York City, after a brief illness, at the age of 77 years.

◆

ROSWELL P. COOLEY, who served as eastern manager of the Vapor Car Heating Company, New York, until about 1934, and had been for many years in the railway supply business, died suddenly on December 21 in the Embassy Hotel, where he made his home in New York City.

◆

SAMUEL G. REA, vice-president of the Standard Railway Equipment Company, whose death on November 16 was reported in the December issue of the *Railway Mechanical Engineer*, was born at Marietta, Ohio. Mr. Rea was educated at the Eastman Business College, Poughkeepsie, N. Y., and first started work with the Vivian Bond & Company, metal importers. He then organized the Century Railway Equipment Company and in 1911 went with the Standard Railway Equipment Company as vice-president in charge of sales in the eastern district, with headquarters at New York. He attended the Second Plattsburg Camp, Plattsburg, N. Y., during the World War and attained the rank of lieutenant-colonel in the 305th Field Artillery.

◆

C. E. EKLIND, vice-president of the Camel Sales Company, a subsidiary of the Youngstown Steel Door Company, Chicago, died in that city on December 1, of a complication of ailments. Mr. Eklind

C. E. Eklind

was born on October 8, 1878, at Orebro, Sweden, and was educated in that country and in Germany where he took post graduate work. He was first employed by the Pressed Steel Car Company, and in 1904 entered the mechanical department of the Atchison, Topeka & Santa Fe, where he served as a designing engineer. In 1923 he resigned to enter the employ of the Camel Company, Chicago, and in 1935 was elected vice-president of the Camel Sales Company, which became a subsidiary of the Youngstown Steel Door Company on December 1, 1937.

Personal Mention

General

M. J. DONOVAN has been appointed mechanical assistant, locomotives, office of the chief mechanical officer of the Chesapeake & Ohio, with headquarters at Cleveland, Ohio.

JOSEPH BRODNAX BLACKBURN, mechanical assistant (locomotives) to the chief mechanical officer of the Chesapeake & Ohio, Pere Marquette and Nickel Plate, has been appointed mechanical engineer, with headquarters at Richmond, Va.

J. A. PILCHER, mechanical engineer of the Norfolk & Western, with headquarters at Roanoke, Va., has retired. Mr. Pilcher was born in Richmond, Va., on January 24, 1868. He attended high school in Petersburg, Va., and, in 1889, at the end of his freshman year at Cornell University, entered the service of the Richmond Locomotive and Machine Works (predecessor of the American Locomotive Company). On January 13, 1891, he became a draftsman in the mechanical engineer's office of

J. A. Pilcher

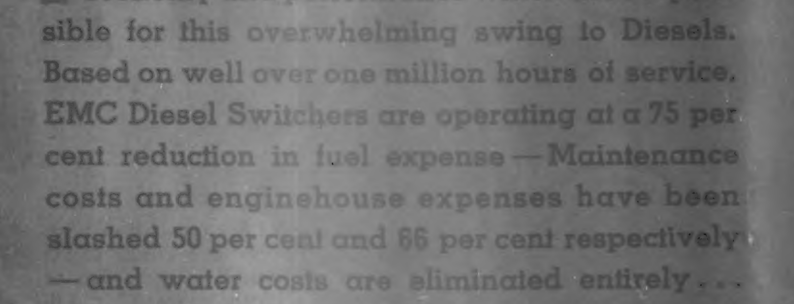
the N. & W. Eight years later he was asked to join the engineering staff of the Baldwin Locomotive Works. Three years later, in 1902, he was called back to the N. & W. as mechanical engineer. During his many years with the railroad Mr. Pilcher supervised the designing of more than a dozen different classes of locomotives. He has been active in the work of the Mechanical Division of the Association of American Railroads and is a life member of the American Society of Mechanical Engineers.

H. W. REYNOLDS, assistant mechanical engineer of the Norfolk & Western, has been appointed mechanical engineer, with headquarters at Roanoke, Va., succeeding J. A. Pilcher, who has retired. Completing his education in the early 1900's, Mr. Reynolds was employed, first, in the test department of the American Locomotive Company at Richmond, Va., then as a machinist in the employ of the Newport News Shipbuilding and Dry Dock Co., and later as a draftsman for the Ball & Wood Company, New York, and the Ironton Engine

Something New in

100%

THERE are many outstanding records of EMC economy and performance which are responsible for this overwhelming swing to Diesels. Based on well over one million hours of service, EMC Diesel Switchers are operating at a 75 per cent reduction in fuel expense—Maintenance costs and enginehouse expenses have been slashed 50 per cent and 66 per cent respectively—and water costs are eliminated entirely . . . Availability is averaging 94 per cent with some records as high as 98 per cent.



ELECTRO-MOTIVE C

SUBSIDIARY OF GENERAL MOTORS L

Company. His affiliation with the N. & W. as a draftsman in December, 1905, followed a period of service with the then Virginia Bridge & Iron Company at Roa-

H. W. Reynolds

noke. In 1918 he was promoted to the position of mechanical inspector, and for four years he was foreman and assistant general foreman in the electric locomotive department of the N. & W. at Bluestone, W. Va. Returning to Roanoke on July 5, 1928, Mr. Reynolds served as mechanical inspector until November 16, 1936, when he was appointed assistant mechanical engineer.

Thomas Britt, general fuel agent of the Canadian Pacific, with headquarters at Montreal, Que., has retired after nearly 51 years of service.

L. E. Grant, chief chemist and metallurgist of the Chicago, Milwaukee, St. Paul & Pacific, has been appointed metallurgical and welding engineer, serving all departments.

Jose Morales Sanchez has been appointed superintendent of motive power of the Southern Pacific in Mexico, with headquarters at Empalme, Son., Mexico, succeeding A. Kasten.

Master Mechanics and Road Foremen

F. A. Lindeman, master mechanic of the New York Central at Avis, Pa., has retired.

C. A. Pease has been appointed master mechanic of the New York Central at Avis, Pa., succeeding F. A. Lindeman.

Ashburne Oliver, assistant engineer of tests of the Norfolk & Western at Roanoke, Va., has been appointed assistant road foreman of engines of the Radford division, with headquarters at Roanoke, Va.

Antone Miller, trainmaster and road foreman of engines of the Toledo division of the Pennsylvania, has been appointed trainmaster and road foreman of engines of the Grand Rapids division, to succeed J. D. Scott, deceased.

Harry N. Rowles, assistant trainmaster of the Pittsburgh division of the Pennsylvania, has been promoted to the position of trainmaster and road foreman of engines of the Toledo division.

W. H. Jackson, assistant road foreman of the Norfolk division of the Norfolk & Western at Crewe, Va., has been promoted to the position of road foreman of engines, Pocahontas division, with headquarters at Bluefield, W. Va.

J. J. Thompson, assistant road foreman of engines of the Radford division of the Norfolk & Western at Roanoke, Va., has been appointed assistant road foreman of engines of the Norfolk division, with headquarters at Crewe, Va.

B. R. Carson, assistant road foreman of engines of the Philadelphia Terminal division of the Pennsylvania, has been appointed assistant road foreman of engines of the Pittsburgh division, with headquarters at Conemaugh, Pa.

P. R. Logue, an engineman on the Williamsport division of the Pennsylvania, has been appointed assistant road foreman of engines of the Philadelphia Terminal division, with headquarters at Philadelphia, Pa.

Shop and Enginhouse

G. E. Payne, gang leader at the Shaffers Crossing shop of the Norfolk & Western at Roanoke, Va., has been promoted to the position of assistant foreman at that shop.

Gilbert B. Price, automatic train control mechanic in the shops of the Norfolk & Western at Roanoke, Va., has been promoted to the position of assistant foreman in the erecting shop at Roanoke.

E. G. Speese, assistant foreman in the erecting shop of the Norfolk & Western at Roanoke, Va., has been promoted to the position of foreman in the erecting shop at Roanoke.

P. T. Briers, general foreman of the locomotive shops of the Chesapeake & Ohio at Charlottesville, Va., has been transferred to the position of general foreman at the Hinton, W. Va., locomotive shops.

Edward L. Richardson, foreman of the erecting shop of the Norfolk & Western at Roanoke, Va., has retired. Mr. Richardson became an apprentice in the employ of the N. & W. on February 12, 1887. He progressed through the positions of gang foreman, foreman and general foreman at West Roanoke, and on February 15, 1918, was appointed master mechanic on the Norfolk division. He returned to the Roanoke shops as foreman, erecting shop on January 1, 1919.

Obituary

William C. Smith, who retired in 1937, as master mechanic of the Missouri-Pacific, with headquarters at Dupo, Ill., died on December 20, at Manchester, Mo.

E. Z. Mann, general mechanical instructor of the Atlantic Coast Line, with headquarters at Waycross, Ga., died at his home in that city on November 3. After acting in various other capacities, Mr. Mann served as road foreman of engines of the Atlantic Coast Line from 1918 to 1927, when he became general mechanical instructor.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

"Kennametal."—McKenna Metals Company, 182 Lloyd avenue, Latrobe, Pa. 24-page catalog, No. 2. "Kennametal" tools and blanks for steel and metal cutting.

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Nickel Alloy Steels.—The International Nickel Company, Inc., New York. Data Sheet No. 1, Section III—a 42-page booklet on the Properties and Uses of Some Cast Nickel Alloy Steels.

◆

Insulating and Cushioning Materials.—American Hair & Felt Company, Chicago. Catalog No. 38. A complete catalog of hair-felt products for thermal insulation, sound absorption and general cushioning.

◆

Contour Sawing.—Continental Machine Specialties, Inc., 1301 Washington avenue South, Minneapolis, Minn. 150-page, thumb-indexed Handbook on Contour Sawing, plus "100 examples of ways to cut machining costs" as submitted by Doall users.

◆

High Production Cutting Tools. — Scully-Jones & Company, Chicago, Engineering Manual No. 400. An unusually comprehensive catalog of standard and special high-production cutting tools. Essentially a book bound in imitation leather and containing 319 8-in. by 11-in. pages. The picture index in the first 17 pages shows each tool and gives its correct name, the reference page on which is additional descriptive data, stock sizes, etc.

◆

Cold-Drawn Steels. — Union Drawn Steel Division of the Republic Steel Corporation, Cleveland, Ohio. 24-page illustrated handbook, "Cutting Costs with Cold-Drawn Steels." A non-technical discussion of the results of cold drawing and the best methods of utilizing the improved physical properties of the steels. Said to be the first published work outlining the full story of the advantages of cold-drawn steels and showing how these steels can be used in reducing the cost of manufacturing machined and structural parts. Designed also to serve as a guide in the selection of materials for such applications.

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Welding and Cutting Apparatus and Supplies.—Air Reduction Sales Co., 60 East Forty-second street, New York. Catalog 22, 32 pages. Depicts hand welding and cutting torches and tips, pressure regulators, fluxes, rods and other supplies, and complete outfits for industrial uses.—Catalog 21, 64 pages. Contains, in addition to those items in Catalog 22, other information dealing with acetylene generators, industrial gases and oxy-acetylene machines, with several pages devoted to pipe-line safety devices, two pages on National Carbide and two on Wilson arc welders.